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Of Nature trusts the mind which builds for aye."—WORDSWORTH.

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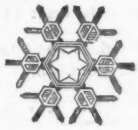

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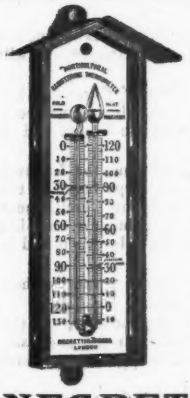

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THURSDAY, JANUARY 9, 1919.

OPTICAL RESEARCH AND DESIGN.

Simplified Method of Tracing Rays through any Optical System of Lenses, Prisms, and Mirrors. By Dr. Ludwik Silberstein. With diagrams. Pp. ix+37. (London: Longmans, Green, and Co., 1918.) Price 5*s.* net.

THERE are two criteria for estimating the value of Dr. Silberstein's latest work. On one hand it possesses great theoretical interest, yet on the other it lays claim to practical usefulness. One must attempt to do justice to both aspects.

From the theoretical point of view the author's suggestion for the tracing of rays through optical systems is deserving of the highest commendation. Progress in the application of mathematics to problems in physical science is largely bound up with the art of economy of symbolical and mental effort, by means of the employment of the briefest possible notation and the most powerful analytical processes. The introduction of the vector notation into geometrical optics is therefore an important step in advance, and Dr. Silberstein is eminently the man to bring this about. He has already done much to initiate English students into the methods of vector analysis, and to convince them of its merits as a tool for the discovery of new results, and as a medium for the brief formulation of discoveries both old and new. In particular he has published some beautiful results of the application of vector analysis to optical research. The latter portion of the present book is a sufficient vindication of the claims of vector methods, and there can be no doubt that they represent the most powerful yet devised for attacking problems on reflection and refraction at systems of plane surfaces.

The optical computer is, of course, interested in plane surfaces; his main task, however, consists in the tracing of rays through systems of spherical surfaces, generally coaxial. In the first half of the book the author develops on vectorial principles the theory of ray tracing through such systems, and here, too, the superior merit of the vector notation is made evident. One must nevertheless remark that his strictures on the old *transfer formulae* are not fully justified, for it is possible to represent the transfer by means of a comparatively short and simple set of equations, even without the aid of vectors.

When, however, we come to the consideration of the practical aspect of the question, some doubts arise as to the merits of the formulæ thus derived. It is a great pity that exact schedules for computation by logarithms or by the calculating machine are not included; they would have greatly enhanced the value of the book. Even one or two actual examples, worked out in full, would have been welcome. It may be that the arithmetical processes contemplated by the author do not justify the suspicion, but one cannot help wondering whether the number of table-entries required by his formulæ does not exceed that required by the well-known Seidel formulæ. Further, it has been pointed out to the present writer that Dr. Silberstein's method possesses the disadvantage of using the cosines of many of the angles. For small angles—and in optical systems most of the angles of incidence, refraction, and convergence are only a few degrees—cosines define the angles with very little accuracy. Thus in the case of angles of about 10° the sines are six times as accurate as the cosines, whilst logarithmic sines are about thirty times as accurate as logarithmic cosines. The further discussion of the vector method in the light of these two criticisms would be very desirable, and students of geometrical optics will welcome any further contributions from Dr. Silberstein's pen. S. BRODETSKY.

PETROL AND PETROLEUM.

(1) *Petroleum Refining.* By Andrew Campbell. With a Foreword by Sir Boverton Redwood, Bart. Pp. xvi+297. (London: Charles Griffin and Co., Ltd., 1918.) Price 25*s.* net.

(2) *Petrol and Petroleum Spirits. A Description of their Sources, Preparation, Examination, and Uses.* By Capt. W. E. Guttentag. With a Preface by Sir John Cadman. Pp. xi+135. (London: Edward Arnold, 1918.) Price 10*s.* 6*d.* net.

THE petroleum industry has developed enormously during the last few years, and processes of production and manufacture of products have so changed from the old "rule-of-thumb" methods which were in vogue in the early days that it is only natural for the literature on the subject to have increased in proportion. In the mass of literature in the English language which has been published on petroleum there has hitherto been no publication on petroleum refining, or one solely confined to petrol and petroleum spirits, both of which are of particular interest at the present time, when we are emerging from the throes of a world-war in which petroleum and its products have played such a prominent part.

Mr. Andrew Campbell, the author of "Petroleum Refining," is one of the pioneers of the British petroleum industry, and his views on the practical side of the subject are the outcome of experienced knowledge. It is rare that technical knowledge, experience, and clarity of diction are found together, but when so found they render the work of their possessor of inestimable value, and it is the possession of these qualities which is strikingly emphasised throughout Mr. Campbell's book.

The volume is divided into nine chapters as follows:—(1) Examination of the crude oil; (2) general departments; (3) storage of crude oil and liquid products; (4) distillation; (5) paraffin extraction and refining; (6) candle manufacture; (7) chemical treatments; (8) distribution of products; (9) engineering specifications; an appendix consisting of a bibliography of the literature (either published in English or of which extracts have been published in English) appertaining to petroleum refining, together with a name and subject

index. The volume is also very well illustrated with 138 illustrations, which include twenty-nine folding plates and three diagrams, and it has eleven comparative tables.

Although in a short review full justice cannot be done to a work which is so full of information as this, yet a glance through the contents table shows its comprehensive character. When the design and erection of a refinery for the treatment of petroleum are projected it is very necessary that the fullest possible information with regard to the crude material should be obtained before anything further is done, and it is significant that the first chapter should deal with this branch. It contains a complete scheme with this end in view, which cannot fail to be of great use to all who are interested in the subject.

Without wishing unduly to criticise a chapter which is so full of necessary information, one would like to suggest that the portion dealing with "flashing points" and "colour" is somewhat too fully dealt with, as this branch appears in most text-books on petroleum, and belongs more to the testing of refined products than to the examination of the crude oil. Of special interest, however, is Fig. 30, giving the designs and arrangements for a five-gallon experimental still, and diagrams 1 and 3 of refining operations and yields of products.

The question of fire risks looms largely in the petroleum industry, and this subject is ably dealt with in chap. ii., which treats also of the departments necessary in refineries, apart from those necessary to actual refining operations. Chaps. iv., v., vi., and vii. discuss exhaustively the actual distillation, refining, and paraffin extractions, as carried out on the large scale, as well as candle manufacture, which in some refineries attains to large dimensions. The subject-matter of these chapters is exceedingly well handled, due stress being laid on the vital points which make for success in these operations, showing the mind of the man who is *au fait* with the general policy, as well as the detailed operations of the manufacture.

Chap. iv., on the subject of distillation, is well worthy of close study, embodying as it does all the up-to-date information available; and in this chapter also attention should be paid to the portion dealing with the question of heat exchange or conservation, as it behoves every oil-refiner to obtain the greatest possible yield from his oil, and by saving fuel a definite conservation results. In the chapter on chemical treatments one would have liked to see more attention paid to the manufacture of lubricants, which is only lightly treated, but is one of the more difficult of the refiners' problems. In this chapter is given a very complete description of the Edeleanu process, which to a large extent lessens the wasteful sulphuric acid treatment of oils. The engineering specifications given in chap. viii. will supply a long-felt want to the student, who so rarely has access to these essential details.

The book will undoubtedly become the standard work on the subject, and should be in the library of each and every person interested in petroleum.

(2) Petrol and petroleum spirits now play such an important part in the economic life of the nation that it is a matter for wonder that so little is known by the general public of their manufacture, constitution, and properties. In the work under notice Capt. W. E. Guttentag, who has had a unique experience in the last few years, has endeavoured to enlighten us, and has compiled quite a large proportion of the available knowledge on the question.

Capt. Guttentag would have been well advised to leave out of the book altogether chap. ii. on petroleum, (*a*) characteristics, (*b*) origin, (*c*) geological, (*d*) exploitation, (*e*) refining of crude oil, or to handle it much more fully than he has done, for the sketchy account which he has given is of little use to the serious student, and is only liable to give unbalanced ideas to the general reader. In any case, it would have been well through the whole of the book to give detailed references to original workers, for without these a technical work loses much of its value. An illustration of this, showing also how mis-statements creep into text-books and are copied and repeated until they are accepted as axioms, is the passage: "The bad smell of cracked spirits . . . is attributed to small quantities of sulphur and nitrogen compounds." This statement was first made by Rittman and then copied by Bacon and Hamor, whereas now it is a generally accepted fact that the smell of cracked spirits is due to that of the unsaturated bodies of the di-ene class which it contains.

The chief value of this work is in chap. v., which deals with the question of examination and testing both for routine and special work, in which the author has freely given of his special knowledge.

The book forms a useful little laboratory guide for those engaged in the testing of petrol.

WOOL INDUSTRIES.

Wool. By Frank Ormerod. ("Staple Trades and Industries." Vol. i.) Pp. xii+218. (London: Constable and Co., Ltd., 1918.) Price 6*s.* 6*d.* net.

THIS work covers in a general way the wool-growing and wool-manufacturing industries. More space is devoted to the sheep and to the wool trade than to the following manufacturing processes, but in no case can the treatment be considered exhaustive.

There are a few sins of omission and of commission which should be corrected in future editions of the work. For example, in dealing with the development of the wool comb on p. 31 no reference is made to the work of Isaac Holden; neither is there reference to the fact that Lister, in purchasing Heilman's English patent, was able to suppress the Heilman comb in Great Britain. It was not until 1900 that this comb, as made by

the Société Alsacienne, reappeared in Yorkshire—then too late, some authorities think, to give the British manufacturer a chance in the short-combed French goods trade.

It is obvious that the author has not followed the interesting work of Prof. Ewart, of Edinburgh University, or he would not refer to the black-faced variety of sheep as being "as near to the original as any breed now existing." The University of Leeds about a year ago purchased a flock of Soay sheep simply to maintain them as a representative pure-bred flock of a type dating back to prehistoric times. The writer's statement that hair will not felt is obviously based on second-hand knowledge, which is not trustworthy; again, the idea that the serrations help to bind the fibres together has now been brought seriously into question. That worsteds will not felt was taught for years in our technical institutes, but thousands of pieces of worsted are now "milled" every day in the West Riding of Yorkshire alone.

There are men still living who have seen the sources of supply of fine wools change from Spain to Silesia and Saxony, and then from Silesia and Saxony to Australia; there are interesting evidences of the changes in the treatment here given to "The World's Wool Supply."

In dealing with "Preparation and Manufacture" the writer shows again a certain lack of grasp of fundamentals, as, for example, in explaining the difference between woollen and worsted, and in referring to healds and mails as "tiny loops of string." Again, on p. 125 it is stated that the needles in a Jacquard are acted on by holes, whereas they are acted on, *not* by holes, but by blanks. There is a serious error in printing the illustration of wool fibres facing p. 42. The block has evidently been turned round by the printers, with the result that the references are altogether misleading.

Having criticised the defects—which, all considered, are few—it is now the author's due that the excellences of the work should be emphasised. In many important respects the work is absolutely up to date. For example, the value of a suitable atmosphere in the spinning-room is interestingly treated. The harnessing of streams of water for power purposes is also referred to, although the author appears to be unaware of the method of electric control of water-power to attain that necessary steadiness in running otherwise unobtainable. As further illustrating the up-to-dateness of the work, reference will be found to the formation of the Agricultural Organisation Society for dealing with British wools on lines similar to those upon which Colonial wools are dealt with; to the use of a woven paper cloth for wool packing; to the development of the "automatic doffer" in the worsted spinning industry; and to the possibilities of the automatic loom in which weaving is done in the dark, any defect in the mechanism at once lighting up the loom, thus indicating the need for attention.

The psychology of the consuming public comes in for indirect attention, and the references to the trade guilds—which appear to be somewhat remarkably resuscitated in our present-day trade combines and trusts—and other matters of historical importance all tend to make the work very interesting as well as directly useful. Upon the whole, the work may be regarded as being among the best of the shorter general guides to the wool trade and the wool-manufacturing industries; its faults are few, and its excellences many.

OUR BOOKSHELF.

Winter Botany. A Companion Volume to the Author's "Plant Materials of Decorative Gardening." By Prof. W. Trelease. Pp. xxxii + 394. (Urbana: Published by the Author, 1918.) Price 2.50 dollars.

IN this handy and concise little volume Prof. Trelease describes the winter characters of 326 genera of trees and shrubs belonging to ninety-three families. With the exception of Larix and Taxodium, the Conifers are excluded, as these, being evergreen, have been adequately treated in the companion volume on "Plant Materials" issued in 1917. The book, though of American origin, includes most of the genera and species which the student is likely to find, wild or in cultivation, in this country, and should prove a useful handbook to the botanist who is interested in the determination of woody plants during the winter season. The generic description is in each case supplemented by a wood-cut illustrating the chief points to be observed, and by a brief key to the species which are likely to be found.

The descriptive matter is preceded by a key to the genera, and instructions are given as to its use. A good pocket-lens is essential to the examination of the characters of the twigs which is required for the use of the key. These characters include the position of the leaves, as indicated by the scars, the form of the scar, the position, number, and form of the buds and stipules (if present), the surface characters of the twigs, the form of the pith, and other easily observed internal characters. As heath-like and some other evergreen plants are included, the form and arrangement of the persistent leaves are considered in these cases. References are also given under the genus to descriptive works in which the winter characters of the plants in question are more fully treated. A useful glossary and a full index of Latin and popular names complete the volume.

The Illinois and Michigan Canal: A Study in Economic History. By Prof. J. W. Putnam. (Chicago Historical Society's Collection, vol. x.) Pp. xiii + 213. (Chicago: The University of Chicago Press, 1918.) Price 2 dollars.

THIS book was originally prepared as a doctoral dissertation of the University of Wisconsin. It is a mine of facts and a concrete illustration of the thesis that canals were a success when there were no railways, but are not a success when faced with the competition of modern railway transport. At the same time the success of this canal was an

early indication that in the opening up of new lands the provision of adequate means of transport must precede the advent of the settler.

A connecting link between the Great Lakes and the Mississippi was necessary. An ancient outlet of Lake Michigan led to the Illinois River, which reaches the Mississippi near St. Louis, and so the State authorities, after overcoming many financial difficulties, eventually made the canal, which was opened in 1848.

Prof. Putnam details these early struggles, blames the "spoils system" for inefficient management and the consequent failure of the canal in later years, and pleads for the construction along the canal route of a waterway suitable for such ocean-going steamers as can at present reach Chicago and St. Louis. Both these cities have progressed in no small degree because they are terminals of the Illinois and Michigan navigation. Chicago in 1831 was a village; from 1848 to 1854 the population of the city rose from 20,035 to 74,500, and in 1870 it contained more than 300,000 inhabitants.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Some Temperature Anomalies.

THE investigations conducted by Hann and others have yielded a complete explanation of the physical processes involved in the production of the Föhn, Chinook, and similar winds met with in various parts of the world—a warm, moist air current depositing its moisture and decreasing in temperature while ascending the windward slope of a mountain range, then on the lee side descending and becoming intensely dry and increasing greatly in temperature as a consequence of the increase of pressure during the descent. But in the British Isles, and no doubt in other regions similarly situated in the neighbourhood of a relatively warm ocean current, there are occasions—and they are by no means uncommon—when a mild, soft sea breeze produces some curious temperature anomalies, which, so far as I am aware, have not attracted the attention of meteorologists and physicists, and, consequently, are thus far without any adequate explanation. They visit this country and western Europe in all seasons, but they are more noticeable in the winter half of the year, because the change of temperature is then relatively much greater than in the normally warm seasons.

Although the feature is observed only with the wind from points between west and south, and perhaps most frequently from about W.S.W., it is far from being an invariable accompaniment of an air current from this direction. On theoretical grounds, and from our conception of the natural order of things, we expect a rise of temperature over this country with a wind coming from the warm region of the Azores and the Lower Atlantic—the increase greatest in the west, nearest the seat of the source of the warmth, then becoming less and less marked during the eastward translation of the air current across the land, so that the bracing east coast of Britain would still be markedly cooler than the west coast of Ireland. The remarkable fact, however, is that actually the exact contrary is the case, the arrival of the warm current producing an increase of temperature on the western coasts, but the increase becoming more and more decided over the cold land, until the temperature in the extreme east is considerably higher than it is on the western seaboard.

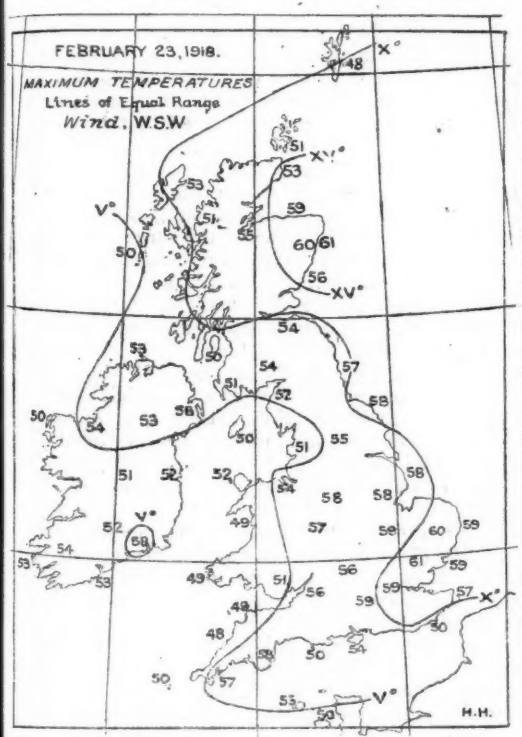
There is in the Meteorological Office publications—the Daily, Weekly, and Monthly Reports for many years past—an *embarras de richesses* of illustrations of this particular feature. An excellent example is afforded by our experience during February 23 of the past year. On the morning of that day we were placed between an anticyclone centred over the Bay of Biscay and low pressure extending across from Iceland to Norway, with the wind at W.S.W. from Shetland southward, and the air temperature already well in excess of the normal in all districts. Over the country generally the thermometer had remained as high as 45° to 51° through the preceding night. During the day, however, the rise of temperature was very slight in the west, while it increased decidedly with the eastward advance of the wind. In the accompanying map the afternoon maximum temperatures are seen to be below 50° along the shores of the Bristol and St. George's Channels, and 50° to 53° on the outer western coasts from the Hebrides down to Scilly. Over eastern Britain, on the other hand, the maxima were 58° and upwards, 60° being reached at Crathes and Geldeston, and 61° at Aberdeen and Halstead. These were about the same as the maxima registered at the Azores on previous days. Even in eastern Ireland 56° were registered in Down, and 58° in Waterford. The day's range of temperature was less than 5° in the west generally, 0° to 3° in several localities, but eastward it increased to more than 10° over the greater part of Scotland and in eastern England, and as much as 15° to 18° in the east of Scotland.

The day was marked by a little rain locally, the general weather being fair to cloudy or overcast, with little or no sunshine over a wide area, and where there was sunshine the temperature was not materially different from what it was in sunless localities. Banff had the best sunshine record, eight hours, with temperature 59°, Cambridge registering the same maximum with one and a half hours of sunshine, and Westminster without a ray of sunshine. There was some sea fog between Pembroke and the Channel Islands to account for the lower temperature records in that region.

This particular instance can be accepted as typical of what takes place on these occasions, but I must refer to one other case, because it is the most extraordinary within my long experience. There were many such during the abnormally stormy conditions which prevailed over the Atlantic in the winter of 1898–99 (see charts illustrating the weather of this period, Meteorological Office, Official No. 142). On February 10, 1899, when the greatest winter cold on record was being experienced in America, the temperature ranging down to −60° in Ontario and −61° in Montana, a south to south-west breeze brought to a great part of Europe unprecedented winter warmth. At Cahirciveen Observatory, on the Kerry coast, the thermometer mounted on that day to 54°. Thence eastward over a distance of at least 700 miles the following maxima were recorded:—56° at Scilly, 57° at Brest and Clifton, 61° at Jersey, 62° at Oxford, 66° in London, 69° at Paris, and 70½° at Liége and Verviers. Still further to the east, another 300 miles, and Berlin and Munich rose to 59°, the whole of central and southern Europe and as far east as the Caucasus experiencing a marked increase of temperature, but

the warm wind did not affect Scotland and northern Europe. The Greenwich, Paris, and Brussels records (in the case of Paris extending back to the middle of the eighteenth century) disclose no other February maxima equal to those experienced on this occasion.

At high levels the crest of this remarkable heat-wave would seem to have lagged during the eastward advance, for at Davos Platz, at an altitude of more than 5000 ft., although the unprecedented February temperature of 53° was reached on the 10th, it was not until the 15th that the very extraordinary winter maximum of 63° was attained, and the same level was touched on the 19th. So exceptional was the warmth that the average maximum for the six days, 15th–20th, was as high as 61°, only one day being below 60°. Within a few days of each other Montana and Switzerland, in about the same latitude and at about the same elevation, had temperatures differing



by 124°, from −61° in a N.W. land-wind to +63° in a S.W. sea-wind.

How are we to account for the noticeable accession of heat which these observations show takes place as the air spreads across the land further and further away from what we regard as the seat of origin of the warmth? Thus far, the only suggestion I have received has been that perhaps it will prove to be of the Föhn character—a descending current. There are difficulties in the way of accepting this view. In the first place, our south-westerly winds are ascending rather than descending currents. We might be able to show that winds from the Atlantic crossing mountainous western Scotland are of the Föhn character on reaching the east coast, but it is scarcely likely that a Scotch Föhn would bring to Aberdeen a February temperature of 64° (more than 20° above the normal), as on the 22nd in 1897. Such eminences as exist in the south are too far distant to windward and of too moderate altitudes to produce any Föhn effect in London and the Eastern Counties, and across northern France, Belgium, and Prussia. The Davos Platz experience does not support the Föhn argument. It should be borne in mind that the phenomenon with which we are now dealing manifests itself at sea-level on the extreme western coasts before any high land is reached, and thenceforward there is a progressive accession of temperature, regardless of mountain and valley, sunshine and dullness, rainfall and dryness, thus placing the subject on a very different footing from that of the Föhn.

Now that the upper-air conditions are being so closely observed, daily and almost hourly, it should be possible at no distant date to accumulate sufficient evidence to make a special investigation of the circumstances, above and below, which combine to produce the temperature effects described above, and thus to enable us to arrive at the correct explanation of their causation and to predict their occurrence.

9 The Grove, Isleworth. HY. HARRIES.

The Perception of Sound.

BEFORE the discussion on the physiology of the internal ear is closed, it might be well to direct attention to a point in connection with the supposed necessity of the auditory nerve transmitting the very large number of impulses corresponding with the vibrations constituting musical tones.

Although the pitch of a particular tone is, say, 640 d.v. per second, it is not necessary that, in order to recognise it, we should listen to that tone for a whole second of time. Prof. McKendrick many years ago demonstrated that we could recognise as distinct from its predecessor and successor a note in a musical composition if it were listened to for only 1/64th of a second. In such a case this would mean that only ten condensations would affect the organ of Corti, and presumably only ten nerve-impulses ascend the auditory nerve. Prof. McKendrick, with whom it was my privilege to be associated at that time, studied the surface of the wax-cylinder records of musical compositions recorded for reproduction by the phonograph.

Since the speed of rotation of the cylinder was known, the number of impressions in the wax corresponding with each of a series of tones could be ascertained; and it was found that, in order to recognise any given tone, it was only necessary to "hear" that tone for not longer than 1/64th of a second. If I remember correctly, a shorter period still was in some cases demonstrated to be sufficient.

Now if, say, 1/100th of a second is long enough, it is clear that the hearing of quite high tones could be effected by a comparatively small number of vibrations or disturbances in the internal ear and of subsequent impulses in the nerve.

A tone of 2000 d.v. per second could be recognised by 20 impulses, and one of 10,000 pitch by 100, and so on. Apparently the auditory nerve is competent to transmit individual impulses of that order of frequency.

It seems to me that attention to this point will make the problem of hearing rather simpler than at first it appears by removing the necessity for believing that, in order to appreciate a note of a given pitch, we require to have the auditory nerve transmitting the large number of impulses corresponding with the large number of vibrations which, according to physicists, is the pitch or number *per second* of that note. In other words, the different tones in a musical composition follow one another with such rapidity that

no particular note is produced for a whole second, and, therefore, not perceived for a whole second.

But, on the other hand, it is clear that we can listen to a high-pitched note for a second or for a minute or for any length of time. When we are hearing a note of 20,000 d.v. per second pitch, we are almost certainly *not* receiving 20,000 impulses per second into the central nervous system. To take an analogy from vision: when we perceive red light, we are certainly not receiving anything like (395×10^{12}) impulses per second, which is the "pitch" of red light. If, in seeing coloured light, such an enormous number of vibrations in the æther affect the retina, there must be something of a very different character as regards frequency, which, ascending the optic nerve, so stimulates the visual centre that we see coloured light.

We have in perceptual consciousness qualitative differences corresponding with objective quantitative differences, an ever-present problem of psycho-physics; and no one has ever suggested that our optic nerves and visual centres are dealing with impulses at many millions a second. Why, then, may we not apply the same reasoning to the ear?

When we are listening to all possible tones from, say, 1000 d.v. per second pitch to 40,000, may we not somehow have in consciousness qualitative differences corresponding with objective quantitative (arithmetical) differences? We cannot, apparently, be more definite than this.

In the case of the eye there is no conceivable possibility of an identity between the rhythm of optic-nerve impulses and that of the vibrations of the æther; is it not by analogy probable that neither is there any direct correspondence between the auditory nerve-impulses and the periodicity of sonorous vibrations?

D. FRASER HARRIS.

Dalhousie University, Halifax, N.S.,
November 29, 1918.

A Mistaken Butterfly.

THOUGH I cannot claim any special knowledge of insect behaviour, I hope you will allow me to make a few remarks on "A Mistaken Butterfly" discussed in NATURE for September 5 and December 12, 1918. I have my doubts as to whether it was the butterflies or the observers who were mistaken. A butterfly does not always alight on a flower, or on what it supposes to be one, but appears frequently to alight for rest. Now, in selecting a resting-place, it will naturally select a good "taking-off" position, and the knob of a hatpin and a golf ball are evidently from the butterfly's point of view good "taking-off" positions, especially the golf ball, it being surrounded by no good "taking-off" places, and its whiteness would help to direct attention to it.

A number of years ago I met two keen entomologists in Italy who were disappointed in not succeeding in capturing a butterfly they particularly wanted, though they had seen a number, but failed to net them. As I knew where that particular butterfly was likely to be found, I took my walk in that direction the following day, and on returning presented my friends with two specimens of the butterfly. These were captured without a net, by what I imagine is a well-known method. When the butterfly alighted I approached it from behind, keeping as well out of the range of its eyes as possible, and moving *very slowly*. When within arm's reach the hand was slowly stretched out, keeping it as low as possible and behind the insect. When the stalking is carefully done a capture is generally made, and the wings, before lifting it, may be folded to prevent their upper surfaces being damaged by contact with the fingers.

Now in the case of the two butterflies referred to, one was picked off a leaf of a bush, and the other had settled on my shoulder. I do not think they are so easily picked up if they have settled on flowers, as they are there on business, and are restless and away whenever they have accomplished their object.

JOHN AITKEN.

Ardenlea, Falkirk, December 17.

THE FUTURE OF BRITISH MINERAL RESOURCES.

NOW that the activities of a number of Government Departments, which were called into existence by the exigencies of the war, are happily likely to be nearing their end, we may hope to see the reports of their work given to the public; it is to be desired that a mass of valuable information, accumulated often at vast expense, should not be relegated to the limbo of a cobwebbed official pigeon-hole, but should be made generally available. It is scarcely to be expected that many of these reports will be as valuable as that lately issued by the Controller of the Department for the Development of Mineral Resources in the United Kingdom (Cd. 9184, price 6*d*. net), seeing that Sir Lionel Phillips was one of the rare exceptions amongst the small army of Controllers appointed by the Government, inasmuch as he had a thorough acquaintance with his subject before he assumed control; perhaps also that is why he did not hold his office for very long. It is characteristic of the attitude of the Ministry of Munitions towards a courageous and capable official under it, that the Minister takes special care to state that he accepts no responsibility for the opinions and conclusions contained in this report.

The report consists first of a summary of the conclusions arrived at by the Controller, and then of a part divided into two sections, dealing with statistics of production and the inferences to be drawn therefrom. For the numerous valuable tables contained in this report the original must necessarily be consulted, but some of the conclusions of Sir Lionel Phillips deserve both study and comment. He shows clearly that the native British production of non-ferrous metals falls far short of our requirements in normal times, as follows:—

	Production. Tons	Consumption. Tons
Lead	17,000 ...	179,000
Tin...	5,139 ...	21,000
Zinc	4,797 ...	185,000
Copper	139 ...	130,000

The tendency of the report is to show that no very great improvement in output is to be expected, except perhaps in a few isolated instances; it is shown that the output of non-ferrous metals has been falling off continuously for the last sixty years. The main causes assigned for this fact are the impoverishment or exhaustion of the deposits, and the increased costs of ore extraction and of pumping on one hand, and fall in value of metal on the other. Sir Lionel Phillips also lays stress

upon the mismanagement of many mines, the unbusinesslike methods employed, and the lack of co-operation and combination amongst mine-owners. He further directs attention to another drawback, of which all engaged in the management of metal mines in this country are only too well aware, in the following words:—"Labour in the non-ferrous mines has in the past been paid on rather a low level; the wages have been, moreover, in many cases the reward for part-time service, many employees having small farms of their own or being habituated to dual occupations. The system is utterly pernicious, and involves great waste of the men's time and energy in going to and from the scenes of respective work, and entails poor efficiency all round. It has endured from time immemorial, and any change that may be brought about now can only be very gradually effected."

This criticism upon the labour conditions is perfectly sound, and will be endorsed by everyone who knows the system of working, especially in our lead and zinc mines. It is evident that with impoverished deposits, poor management, and inefficient labour the outlook for the non-ferrous metal-mining industry is not a very bright one. There are, however, a number of other difficulties to be contended with; perhaps the most serious is the question of taxation. It is clearly pointed out that "mines are, at best, wasting assets," and that "in all mines earning profits the amounts distributed to proprietors as dividends or profits consist not only of income, but include the return of capital as well. . . . To tax mining profits on this basis is to tax capital as well as income, and to differentiate unfairly against persons who invest in mines." Furthermore, the present system of taxation discourages the formation of a reserve fund to meet the inevitable fluctuations of mining, and as the report says: "Reserve funds so derived should not be taxed. Similarly, the tax-gatherer should not levy toll upon sums spent out of profits in development." Sir Lionel Phillips does not go on to draw the inevitable inference that the unhappy state of the metal-mining industry has to a large extent been brought about by this injudicious system of taxation; it is, however, clear enough that the discouragement of development must tend to leave mines impoverished or exhausted, since it prevents the discovery of new deposits or shoots of ore. It is hopeless to expect a sound policy of management when the accumulation of a reserve fund, which should form the basis of such a policy, is mulcted in taxes. Sir Lionel Phillips does not think that compulsion could be applied to force mining companies to set aside each year out of profits sums estimated as sufficient to redeem their capital; in France, however, the building up of a "legal reserve" is obligatory, and the system appears to work quite satisfactorily.

There is very much in this report that will repay careful perusal, and stress may well be laid upon the recommendations which urge the formation of a Mines Department for the United Kingdom, this Department having for its object the study and encouragement of the home mineral industry. The report is careful to point out that nothing more than advice and assistance is required from a Government Department; as the Controller says: "That there has been too little interference by Government in the past will be generally admitted. That there can well be too much interference is equally obvious. . . . Government cannot, I believe, undertake any industrial work as efficiently as individuals whose material well-being depends upon the result. The nationalisation of mines would, therefore, be disadvantageous to the country. . . . In most industrial enterprises, and certainly in mines, there is an element of hazard which fortune-seekers are willing and are bound to take, but which the Government ought not to, and permanent officials never would, take." There is no doubt that these opinions would receive the unanimous endorsement of all mining engineers experienced in the direction of British mining enterprises, and it is to be hoped that the Government of the country will give heed to the findings of the Controller of this important Department of national industry.

H. LOUIS.

SUPERSATURATION AND TURBINE THEORY.[1]

IT has become of late years increasingly obvious that the equilibrium state of saturation, assumed as the basis of the theory of the steam-engine, does not apply accurately to the case of rapid expansion, especially in turbines. Steam in rapid expansion does not even begin to condense until its temperature has fallen far below the saturation limit. This fact has been familiar for many years as a general property of vapours called supersaturation, but it was not realised until recently that it might produce effects which could not be ignored in practice. Many authorities (*e.g.* Prof. Rateau, "Flow of Steam," 1905) held that there was no appreciable retard in the condensation even in a steam-nozzle where the expansion reaches the limit of rapidity. On the other hand, Callendar and Nicolson (Proc. Inst. C.E., 1897) found experimental evidence of supersaturation in the cylinder of a reciprocating engine at comparatively low speeds. Assuming that the adiabatic of supersaturated steam was simply a continuation of that of superheated steam, they calculated that a loss of 20 per cent. of available heat-drop would result at low pressures if there were no condensation; but as there was known to be a limit to the state of supersaturation they estimated that the actual loss due to this cause would not exceed 5 per cent. to 10 per cent. in practice, depending on the range and rapidity of expansion.

The first definite measurement of the supersaturation limit was obtained by Mr. C. T. R. Wilson (Phil. Trans. R.S., 1897) by expanding water vapour mixed with air at 20° C. It was found that the mixture could be expanded in the absence of dust or other nuclei without any con-

[1] "A New Theory of the Steam Turbine." By Harold Medway Martin. Reprinted from *Engineering*, vol. cvi. Pp. 22+folding diagram.

densation occurring until the density of the vapour was about eight times that of saturation at the lower temperature, but that beyond this point the condensation was so dense as to suggest that a natural limit of supersaturation had been reached. Experiments on steam-jets by Barus and others suggested a similar limit for steam at high temperatures free from air, though the precise ratio of density required could not be directly obtained from such experiments. Taking the density ratio given by Wilson as the limit of supersaturation, the discharge through a nozzle was calculated by Callendar (Proc. Inst. Mech. Eng., January, 1915), and shown to afford a reasonable explanation of well-known anomalies.

Admitting the supersaturation limit thus defined, the discharge through a nozzle comes out about 5 per cent. greater than that given by the older view, and agrees much better with the results of experiment. The available heat-drop to the supersaturation limit is about 5 per cent. less, involving a corresponding loss of work. So far the result is definite, depending only on the limit assumed and the equation of the adiabatic, which is fairly certain. Beyond this point the loss must depend on the rate of expansion, but it is still possible to calculate an upper and a lower limit. The maximum heat-drop is obtained by assuming that, when once condensation has started, the temperature follows the ordinary saturation limit in isentropic expansion, in which case there is no further loss of available heat-drop. On the other hand, assuming that the temperature cannot fall appreciably below the supersaturation limit, however rapid the expansion, the maximum *loss* is obtained by assuming that the temperature follows the supersaturation limit, in which case the loss continually increases with increase of entropy, but reaches a nearly constant percentage, about 8 per cent., of the total heat-drop at low pressures.

In the work before us the author adopts a slightly different definition of the supersaturation limit. Instead of taking a simple ratio of densities as proposed by Wilson, he assumes that the effective radius of the supersaturation nucleus remains constant at different temperatures. In the absence of experimental evidence at high temperatures, it is scarcely possible to decide between the two assumptions, except that the first is the simpler in application. The two corresponding curves for the supersaturation limit agree so closely at pressures between 1 lb. and 15 lb. that they give practically identical results when applied to any turbine problem. Now that one of the leading exponents of turbine theory has set the example we may confidently expect that other useful applications of the supersaturation hypothesis will follow, and that more accurate determinations of the limit will be made in the near future.

The "New Theory" gives an example of one such application of great practical interest—namely, the effect of superheat in improving the efficiency, which confirms the hypothesis of supersaturation, and throws light on the probable state of the steam in an actual turbine by comparing theory with experiment.

According to the older theory of isentropic expansion of saturated steam, the effect of a moderate degree of superheat in improving the relative efficiency of a turbine should be practically negligible, whereas even the earliest experiments in this direction showed that the improvement was strongly marked. The improvement was generally attributed to elimination of friction due to the presence of water (Stodola, "Steam Turbines," p. 137), but Osborne Reynolds showed this explanation to be unsatisfactory. The supersaturation theory of expansion requires that the improvement should be most marked in the early stages of superheat, owing to the reduction of supersaturation losses, which diminish most rapidly with the first rise of temperature. The most trustworthy and recent experimental results on the improvement due to superheat are probably those given by the correction curves of Baumann (Journ. Inst. Elect. Eng., 1911), which are generally regarded as accurately representing the case of the modern high-speed turbine.

Mr. Martin shows that these results can be satisfactorily explained on the supersaturation hypothesis provided that we are prepared to admit that the temperature of the steam, after condensation has set in, remains much nearer the supersaturation than the saturation limit, dividing the interval in the ratio 1 to 4. His method, involving the estimation of reheat factors, may appear indirect, but tends, if anything, to exaggerate the effect of superheat in reducing the supersaturation losses. The present writer has made many similar calculations, which corroborate Mr. Martin's, and tend to show that the temperature of the steam must be very near the supersaturation limit in the later stages of expansion in a high-speed turbine. A result so strongly at variance with the generally accepted theory cannot fail to act as a stimulus to further research on the effects of supersaturation, and may lead to appreciable improvements in design when proper account is taken of these essential physical properties of steam.

H. L. CALLENDAR.

THE EPIDEMIOLOGY OF PHTHISIS.[1]

TUBERCULOSIS, and particularly pulmonary tuberculosis (phthisis, or consumption of the lungs), still remains one of the health problems of the age. The Medical Research Committee has, therefore, been well advised to institute an inquiry into the epidemiology of phthisis in Great Britain and Ireland, of which this report by Dr. John Brownlee is the outcome.

The present investigation is a statistical analysis of the Registrar-General's returns of mortality, mainly for the five decades 1851–60 to 1891–1900, for the constituent countries as a whole and also for certain districts of them. By this means remarkable differences are brought out respecting the age at which the maximum death-rate from phthisis occurs in different localities. If we take the deaths of males from phthisis in England and

[1] An Investigation into the Epidemiology of Phthisis in Great Britain and Ireland. Medical Research Committee, Special Report Series, No. 18.

Wales for 1901–10, the death-rate rises from 250 per million at fifteen years of age to a maximum of 2750 per million at forty-seven years of age, after which it steadily declines to 500 per million at eighty years of age, the curve being almost symmetrical. For London the curve is much the same, though steeper, because the maximum death-rate is higher, being 4500 per million at fifty years of age. Lancashire and Staffordshire show a very similar curve. If, however, we take the figures for North Wales for males for the same period (1901–10), the death-rate rises abruptly from 500 per million at fifteen years of age to 2800 per million at twenty-three years of age, continues at about this level up to fifty years of age, then rises slightly up to sixty years of age, and then declines (the curve for Norfolk is much the same). The curves for London and for North Wales are thus utterly different. Cornwall shows a well-marked secondary rise, and the form of the curve is the same whether the tin-miners, who are specially prone to phthisis, be included or not. For this county the phthisis death-rate rises to about 2600 per million at thirty years of age, declines to 1300 per million at forty years of age, rises again to 3250 at sixty years of age, and then falls.

Similar differences are met with in Scotland. The phthisis death-rate among males in Shetland for the years 1881–1900 rises steeply to 6000 per million at twenty-three years of age; it then falls almost regularly to 1500 per million at fifty years of age, and continues at about this level until seventy is reached. For Midlothian, including Edinburgh, on the other hand, the curve is very similar to the London one, with a maximum death-rate of 3750 per million at 42½ years of age. For Ireland the curve is not unlike the Shetland one, a maximum death-rate of 4500 per million being attained at twenty-seven years of age, with the exception that it declines almost regularly to 500 per million at seventy-five.

From these and other data the conclusion is arrived at that phthisis or consumption of the lungs is not a single disease, but rather a group of diseases, of which one type attacks the young adult, the commonest age of death lying between twenty and twenty-five; a second type has its incidence at middle life, killing most commonly between forty-five and fifty, while a third type may exist, but less certainly distinguished, with its chief mortality between fifty-five and sixty-five. In diseases such as cerebro-spinal fever and pneumonia four or five different races or varieties of the respective specific micro-organisms are now known to exist, and the results of this statistical inquiry suggest that something of the same nature may obtain as regards the tubercle bacillus of pulmonary tuberculosis or phthisis. In the introduction to the report it is stated that the bacteriologist has not yet discovered "type" differences among the human tubercle bacilli of phthisis. This statement is not altogether correct, for certain observers have arrived at the conclusion that there are at least two types of the human tubercle bacillus of phthisis with distinctly different properties, which may be differentiated by certain methods. Other matter of considerable interest is also included in the report, viz. an examination of the phthisis death-rate in London since 1631, the relationship of phthisis to certain occupations (among tin-miners the death-rate is 16,500 per million at fifty to fifty-five, while among coal-miners it never rises above 2000), and the relationship of phthisis to environment. The report is illustrated with twenty-six diagrams showing the phthisis and other death-rates in graphic form, which give a far better idea than words could do of the variations alluded to above.

R. T. HEWLETT.

NOTES.

THOSE engineers who have been advocating the electric drive of ship propellers will read with mixed feelings the announcement made on January 2 by Mr. Daniels, the Secretary of the U.S. Navy, that in the future all the capital ships of that Navy will be electrically driven. There is no reason to doubt that the new American Dreadnought—the *New Mexico*—is a great success. Steam turbines are used, and in order to get their highest efficiency they must be kept running at high speeds. The ship's propellers run at much lower speeds, and so direct driving is out of the question. The turbines are directly coupled to dynamos, and the electric power generated is transmitted to motors directly coupled to the propellers. The relative speed of the turbines and the shafts can be adjusted to any desired value with the greatest ease by merely turning the controller-handle. The experiments undertaken in this country a few years ago were carried out in a timid and hesitating way both from the engineering and the financial point of view, and the results were generally disappointing to the electrician designers. It is possible, but by no means probable, that slow-speed turbines may be developed in the future. In the meantime, we hope that British shipbuilders will make larger use of the electric drive in the future than they have in the past.

THE *Times* for January 3 announces that the world's altitude record has been broken by a British biplane, which flew from Martlesham Heath and attained a height of 30,500 ft.—1500 ft. higher than the summit of Mount Everest. The machine was piloted by Capt. Andrew Lang, R.A.F., with Lieut. Blowes as observer, Capt. Lang having previously made two attempts to beat the American record. It is of considerable interest to note that the height attained was limited by the failure of petrol-pump pressure, due to the rarity of the air, and not by the aerodynamic performance of the machine. The machine was fitted with a Napier Lion engine, but it is not stated whether forced induction was employed to keep up the engine power at this enormous altitude, where the air density is only 28 per cent. of its ground value and the temperature of the order −40° C. It would appear, however, that even greater heights could be reached if minor difficulties, such as those connected with carburation at low temperatures and the maintenance of the pilot's comfort, were overcome. Meanwhile, it is gratifying that the record should be held by British aviators, and we hope that it may continue to be so held in the future.

PRESIDENT WILSON has been given a most cordial reception in Rome during the past few days. He has been admitted a member of the ancient Accademia dei

Lincei, and on January 4 received representatives of the chief universities of Italy. We learn from the account of the visit given by the *Times* correspondent at Rome that the first to be presented were representatives of the University of Rome, headed by the rector, Prof. Tonelli. Signor Salandra, as president of the faculty of law, read an address in Latin recounting the achievements of the President, and conferring on him the degree of doctor in jurisprudence (*honoris causa*). The diploma was then presented by Prof. Tonelli. There followed representatives of the University of Padua, headed by Prof. Lori, who conferred on the President the degree of doctor of laws. Next came the turn of the University of Bologna. Mr. Wilson had already received a degree from the university, but Prof. Galanti gave a special greeting in the name of the university. Last came the Marquis Torrigiani, who, in the name of the University of Florence, conferred on the President the degree of doctor in letters.

THE Director of the British Museum (Natural History) has received the following letter from the National Museum of Natural Sciences, Madrid:—"Please let us congratulate very warmly your museum on the end of the great war, so glorious an end for your country and for the cause of universal freedom and peace.—Believe us, sir, yours very friendly, Ignacio Bolivar (director), Eduardo H. Pacheco, Joaquin Gonzalez Hidalgo, Luis Lozano, Lucas F. Navarro, Angel Cabrera, Antonio de Zulueta, Ricardo Mercel, Cándido Bolivar, and Romualdo Gonzales Fragoso." The director of the Museo Nacional wishes the letter to be taken, not as a mere formula of courtesy, but as an expression of sincere feelings of sympathy on the part of the signatories towards this country. We feel sure that our readers will cordially appreciate and reciprocate this friendly message from Spain.

THE Faraday Society has arranged a general discussion on "The Present Position of the Theory of Ionisation," to be held on Tuesday, January 21, from 5 to 6.30 and from 8 to 10 p.m. in the rooms of the Chemical Society, Burlington House, W.1. Sir J. J. Thomson will preside over the discussion, which will be opened by Prof. G. Senter. Among contributors of papers will be Prof. S. Arrhenius (Stockholm) Prof. S. F. Acree (Syracuse, U.S.A.), Capt. J. W. McBain, Mr. W. R. Bousfield, Dr. E. Newbery, Dr. N. R. Dhar (Paris), Dr. Henry J. S. Sand, Prof. A. W. Porter, Dr. E. B. R. Prideaux, and Capt. J. R. Partington.

WE notice with much regret the announcement of the death on January 6, at sixty years of age, of Col. Theodore Roosevelt, ex-President of the United States of America, and distinguished in the scientific world by his observations on big game and his work for the establishment of bird reservations and other means of conserving places and objects of natural beauty and interest.

THE death is announced, in his eighty-ninth year, of Dr. Thomas Buzzard, consulting physician to the National Hospital for the Paralysed and Epileptic, Queen Square, London; ex-president of the Clinical, Neurological, and Harveian Societies; a foreign corresponding member of the Société de Neurolgie of Paris; and the author of many works on diseases of the nervous system.

NEWS has just reached us of the death on October 1 last, in his sixty-first year, of the distinguished mathematician-philosopher, Gaston Milhaud, professor at the Sorbonne, Paris. Prof. Milhaud occupied an almost unique position, indicated in the special subject for which his chair was created by the Sorbonne in 1909, "History of Philosophy in its Relations with the Sciences." His strong historical sense made him especially sympathetic as a philosopher, and enabled him almost instinctively to place himself at another philosopher's point of view—a rare intellectual gift. His first published work, "Leçons sur les origines de la science grecque," appeared in 1893, and marked the special direction of his studies. It was followed in the next year by "L'Essai sur les conditions et les limites de la certitude logique." This was his thesis for the Doctorat ès lettres, and aroused great interest, passing through several editions. Prof. Milhaud is better known in this country by his books "Les philosophes géomètres de la Grèce" and "Etudes sur la pensée scientifique chez les Grecs et les Modernes." During his last years he had been engaged on a special study of Descartes. Portions of this have appeared from time to time in reviews, and the whole, we hope, will now be published.

COUNT HERTLING, German ex-Imperial Chancellor, was one of the great political leaders who combined philosophy as a profession with statesmanship. His first professorship was at Bonn, and in 1880 he became ausserordentliche professor of philosophy in the University of Munich. His principal books are "Materie und Form und die Definition der Seele bei Aristoteles" (1871), "Ueber die Grenze der mechanische Naturerklarung" (1875), "Albertus Magnus" (1880), and "John Locke und die Schule von Cambridge" (1892). He was also the author of numerous articles on political philosophy.

OWING to the exciting events which were happening last year, the death of Marcel Deprez, one of the greatest of electricians, on October 18 last, has almost passed unnoticed in this country. In his early life Deprez made many valuable researches by means of various novel devices on the pressures developed in cannons during explosion. It was not until 1881, however, when he was thirty-eight years old, that he devoted himself to the application of electricity to industrial purposes. In that year, in conjunction with Carpentier, he patented the method of transmitting power by high-tension electricity, using step-up and step-down transformers. His profound faith in theory enabled him to surmount the many difficulties with which the early pioneers of power transmission were faced. Deprez was the first to prove that the method was commercially feasible. His study of the curves devised by John Hopkinson to explain the working of a dynamo led him to the invention of the compound winding by means of which the voltage of a dynamo can be maintained constant at all loads. In conjunction with d'Arsonval and Carpentier he invented a series of measuring instruments which are in common use in every country in the world. In 1890 Deprez was elected professor of industrial electricity at the Conservatoire des Arts et Métiers. A long illness and the war prevented him from completing several important scientific and industrial researches on which he was engaged. We unite with our French *confrères* in paying homage to the memory of one whose inventions have played such a notable part in the industrial development of the world.

THE death at Tacoma, Washington, U.S.A., on November 14, 1918, is announced of Prof. George Francis Atkinson, head of the department of botany at Cornell University since 1896. Born in 1854, and educated at Cornell, where he graduated in 1885, Prof. Atkinson was appointed associate professor of cryptogamic botany at his own university in 1893. In 1894

he issued, under the title of "The Study of the Biology of Ferns by the Collodion Method," a useful, practical study of fern-structure, especially of the sporangia, spores, prothallia, and embryo. But his work was mainly on the fungi, and he published numerous papers on the life-history, physiology, and taxonomy of members of this group. Much of his work dealt with fungi as the cause of disease, especially in cotton and other cultivated plants. As a guest of the British Association and an active member of the meetings of the International Botanical Congress at Vienna in 1905 and at Brussels in 1910, Prof. Atkinson was known personally to many British botanists. He took a keen interest in the meetings of the Section of Nomenclature at Vienna and Brussels, particularly as regards the various groups of cryptogams.

ON January 1 last, by arrangement with the Director of the Meteorological Office, the *Morning Post* commenced the regular publication of the weather map of the previous evening (6 p.m.). The map, two columns wide, is on the same scale as those for 1 a.m., 7 a.m., and 1 p.m. which are given in the official Daily Weather Report. There would seem to be considerable delay in the telegraph service of observations from France, for while reports from the Low Countries, Scandinavia, and Iceland arrive in time for inclusion in the map, those from France are conspicuous by their absence so far. Their prompt arrival would add greatly to the value of the map. Wireless reports from ships out at sea are to be added as soon as the new service is organised.

THE year 1918 ended with a remarkably mild December, the mean temperature at Greenwich for the month being 45·8°, which is 5·8° in excess of the normal. The whole month was mild except two days at Christmas and on December 20 and 21. The mean temperature was 2·6° higher than November, and it was warmer than any of the months from January to April inclusive. December was also very damp, although the rainfall was 0·25 in. less than the normal. At Greenwich the mean temperature for 1918 was 50·5°, which is 0·5° above the average. The warmest month was August, with a mean 62·9°, and in July the mean was 62·6° January was the coldest month, with the mean 39·7°. The change of temperature from month to month was greatest from April to May, the mean increasing from 45·2° to 56·4°, a difference of 11·2°. Rain fell on 190 days at Greenwich during the year; the aggregate measurement was 28·5 in., which is 5 in. more than the normal. July was the wettest month with 7·34 in., which is 5·16 in. more than the normal; the month was the wettest July on record, whilst October, 1880, is the only month at any period of the year with a heavier rainfall during the last hundred years. September was also very wet, the rainfall measuring 2·72 in. more than the normal, and at Greenwich it was the wettest September since 1896; of recent years September has been generally dry. March was the driest month with 0·97 in., and February was almost equally dry. Snow fell in London on seventeen days, all from January to April; there was no snow during the later months of the year. Bright sunshine was registered for 1510 hours, which is forty-two hours more than the normal. June was the brightest month with 224 hours' duration of sunshine, and December the dullest with only twenty-six bright hours.

PROF. DE QUERVAIN, the well-known Swiss seismologist, has made a suggestion which deserves the very careful attention of our military authorities and of scientific men in this country. There are at present large stocks of high explosives in every country which cannot be preserved and must be denitrated or exploded. He suggests that fifty tons should be exploded at definite times and under various atmospheric conditions, and that observers in all the surrounding area should be requested to listen for the sound. Prof. de Quervain is discussing the necessary arrangements for making such experimental explosions in Switzerland with the military authorities of that country; and it would be difficult to support too strongly his wish that concurrent experiments should be made in Great Britain. If made in the neighbourhood of seismological stations—for example, near Eskdalemuir—the experiments might be of military value. They could not fail to throw far more light than accidental unprepared explosions on the many problems presented by the transmission of sound-waves by the atmosphere. We may add that the Swiss War Office has already presented ten thousand kilograms of lead and steel from its surplus stores for the bob of the new three-component seismograph.

WE have received from the Scripps Institution for Biological Research, University of California, a copy of a lecture by Dr. Francis B. Sumner on the value to mankind of experiments on animals. Public opinion over here tends to dismiss the subject as *chose jugée*: and one of the many lessons of the war has been in the proof that thousands and thousands of our men have been safeguarded against typhoid and tetanus by methods gained from experiments on animals. Perhaps in the United States there is more need of this sort of scientific propaganda: and this lecture is a very good historical review of the whole subject. We will not here go over the ground which we have won. But Dr. Sumner makes a point which some of us are apt to forget. He directs attention to the fact that some of the more violent opponents of all experiments on animals are not only lovers of animals, but haters of science and of orthodox medicine. He quotes, for instance, an invitation from the lady who is president of the New York Anti-Vivisection Society to "all anti-vaccinationists, anti-vivisectionists, eclectics, homœopaths, chiropaths, osteopaths, naturopaths of all branches, Christian Scientists, New-Thoughtists, Theosophists, Medical Freedomists, and all brave and honest physicians of the allopathic school (who secretly denounce the machinations and conduct of the political doctors) to enrol as active participants in an Association of Free People against Medical Tyranny." And there are one or two people among us over here who talk more or less like this. It may be perfectly true that the medical man is no better than he ought to be. But, as Dickens says, what a blessing it would be if we were all of us only as good as we ought to be!

THE Kew Bulletin (No. 10, 1918) contains a remarkable letter sent to Kew by the late Mr. C. O. Farquharson, mycologist in Nigeria, who was drowned as the result of the loss at sea through collision of the s.s. *Burutu*, on which ill-fated ship he was coming home on leave (see NATURE, November 7, 1918). The letter is an epitome of Mr. Farquharson's life-work in Nigeria, and gives a very graphic account of the nature of the work of a tropical mycologist, the methods by which he sought to solve the many difficult problems with which he was confronted, and the kind of education that his experience had led him to believe best for such work. In the course of the letter some interesting observations on the cultivation of ground-nuts and on cacao diseases are recorded. The main theme of the letter is that most tropical diseases of cultivated plants are amenable to good cultivation and proper sanitation, and that spraying and the introduc-

tion of entomogenous fungi to kill insect pests are rather an expression of ignorance than a real means of combating the troubles due to insect and fungus pests. The letter is deserving of careful attention by all tropical mycologists and by those interested in problems of tropical agriculture, as well as by those who are concerned with the training of mycologists for work in our Colonies.

THE botanical collections made on Mount Korinchi, Sumatra, by Messrs. C. H. Robinson and L. Boden Kloss have recently been worked out by Mr. H. N. Ridley and published in vol. viii., part iv., of the Journal of the Federated States Museums. Mr. Ridley has described the flowering plants and ferns, and the accounts of the mosses and Thallophytes are the work of Mr. H. N. Dixon and Miss Lorrain Smith respectively. These collections throw much light on the highland flora of Sumatra, and it is remarkable that the flora of so large and accessible an island should heretofore have received so little attention. One new genus, Hovella, and no fewer than one hundred and forty-two new species of plants are described, a large number being orchids. It is of interest to find that there is a considerable Himalayan element present in the Sumatran highlands, and some of the genera are also found in Borneo and Malaya. In Malaya, however, they occur only in the Telom mountain district. The Sumatran and Javan mountain floras appear very similar. Two interesting plants, *Goodyera schlechtendaliana* and *Potamogeton oxyphyllus*, var. *fauriei*, have, previous to this, only been recorded from China and Japan. The distribution of the Gesneraceæ is also very interesting, and affords ground for a comparison of the floras of India, Malaya, and Java with that of Sumatra. A very remarkable new Carex, *C. hypolytroides*, was found at 7300 ft. on Korinchi Peak, with stems 6 ft. in height, the whole plant being quite distinct in appearance from any other known Carex.

A VALUABLE contribution to West Australian botany, made by Dr. C. H. Ostenfeld, of Copenhagen, has appeared in *Dansk Botanisk Arkiv* (No. 6, 1916, and No. 8, 1918). Dr. Ostenfeld's studies are based on his visit to Australia with the British Association in 1914. In the first part the "sea-grasses" belonging to the families Potamogetonaceæ and Hydrocharitaceæ are described, with an excellent series of figures in the text, and a new species, *Cymodocea angustata*, is described. A full biological account, including a description of the peculiar vivipary of *Cymodocea antarctica*, is given under each species. In part ii. particular attention is given to the genera Triglochin, Crassula, and Frankenia, with good plates and text-figures, several new species being described. The opening paper consists of a general account of the vegetation with a map, and the mangrove formation, the sandy seashore formation, the salt-pan formation, the sand-dune formation, and the savannah forest formation are discussed in detail. An interesting and characteristic tree of the savannah forest is *Adansonia gregorii*, the only species of this genus known outside Africa. All the other species are confined to tropical Africa, and the original home of the genus appears to have been Madagascar. The Chenopodiaceæ collected by Dr. Ostenfeld are described in part ii. by Dr. O. Paulsen, and four new species are described and figured.

A BRIEF, but extremely interesting, account of the spawning of the little smelt (*Leuresthes tenuis*) appears in *California Fish and Game* (vol. iv., No. 4). This fish appears in immense shoals on all sandy beaches near San Diego during March, April, and May on the second, third, and fourth nights after full moon at full tide. Huge schools then make for the mouth of small fresh-water streams for the purpose of spawning in the sand. The fish apparently strive to get as far shoreward as the waves will carry them. As the water recedes each wriggles down into the sand, at the same time releasing eggs and sperm. The reproductive products discharged, the return to the sea is made by springing back into the next high wave that reaches them. The fertilisation of the eggs thus laid in the sand is effected during the churning-up of the sand by the waves as they rush up the beach. Since these events take place at night, usually from ten to one o'clock, those who have made these observations are to be congratulated, for they have accomplished much under very trying conditions.

THE *American Museum Journal*, vol. xviii., No. 6, contains a brief description of a remarkably perfect skeleton of an Oligocene alligator, from the Big Bad Lands of South Dakota. Though found some years ago, the fossil has only recently been extracted from its matrix. This is a find of some importance, and an excellent photograph of the specimen accompanies this description. It was apparently an immature example, and is minus the tail. But the dermal armature is most wonderfully preserved.

THE thirty-second annual report of the Marine Biological Station at Port Erin shows that in 1918 there were sixteen workers, including eleven senior students in the usual Easter Vacation class. Miss Mayne records some preliminary observations on common littoral organisms with the object of ascertaining the possible density of the population. Choosing the most thickly covered parts of the shore, she found on one square foot of rock 2940 barnacles (*Balanus balanoides*), on another square foot thirty-seven limpets, and in a small pool there were within a square foot twenty-five anemones—twenty Actinia and five Sagartia. Appended to the report is an address by Prof. Herdman on some periodic changes in Nature, with special reference to the changes in the alkalinity of the water of the Irish Sea and the correlated changes in the nature of the plankton.

A REPORT by Prof. Sheridan Delépine on the method recommended by the Sub-Committee of the Anthrax Committee for the Disinfection of Anthrax-infected Wool (see NATURE, June 13, 1918, p. 290, and July 4, p. 347) has been issued (vol. i. of the Report to the Home Office of the Departmental Committee on Anthrax). Prof. Delépine approves generally of the method of disinfection proposed. He directs attention to the importance of temperature in the process—a certain strength of formol which may not destroy the anthrax spores at a lower temperature becomes effective at a higher temperature. The process requires large quantities of warm water for washing the wool, and this wash-water must not be discharged until thoroughly disinfected. The process is applicable only after the bales of wool have been opened, and offers no protection to the workmen engaged in this preliminary work. To be effective also, the process must be carried out thoroughly, the strength of disinfectant and the temperature at various stages being under constant and accurate scientific supervision, and the results frequently controlled by searching tests.

THE Orders which placed glycerine, benzine, methylated spirit, and turpentine on the prohibited list have probably caused much inconvenience to microscopists. In the Journal of the Royal Micro-

scopical Society for September Mr. John Ritchie, jun., describes some experiments on the use of acetone as a solvent for resinous media. Several methods of preparing balsam in acetone are described. The use of acetone enables the object to be transferred directly from alcohol without the intervention of oil of cloves, but balsam so dissolved appears to have a lower refractive index than in cases in which xylol or benzole is the solvent. In this connection it may be mentioned that a recently introduced "turpentine substitute" answers well for thinning balsam that is in a slightly viscid state.

THE Saxon State Railways are now submitting their engine-drivers and other responsible train officials to certain tests in their psychometric laboratory at Dresden. According to the *Zeitung des Vereines deutscher Eisenbahnverwaltungen* (October 2), the tests comprise strength of will and endurance, and fatigue where there is physical strain. The Dubois ergograph is used for the purpose, the object being to trace a fatigue curve. The forearm rests on the table; over the middle finger is run a catgut loop, which passes over a pulley, the other end of the gut supporting a weight of from 4 to 8 kg., according to the suitability of the subject. When the middle finger is bent the weight is raised, and when relaxed again the weight is dropped, the process of this motion being traced on a recording drum. With every stroke the drum advances 1 mm., and every two seconds a clockwork movement records a time mark, so that fatigue in terms of time can be read from the final curve. In addition to giving the mean efficiency in metre-ergs per second, the ergogram also shows the degree of fatigue (*i.e.* diminished efficiency) per minute, as well as the number of lifts which the subject has to make in order to do 1 metre-kilogram of work. The system has been said to give satisfactory results as regards the selection of men for the proper posts.

AMONG announcements of forthcoming books of science we notice the following:—"A Source Book of Biological Nature Study," E. R. Dowling, and "The Geographic and Economic Foundations of the Great War," J. P. Goode (*Cambridge University Press*); "Studies in Neurology," Dr. H. Head, 2 vols., illustrated; "Menders of the Maimed," Prof. A. Keith, illustrated; "A Physical Interpretation of Shock, Exhaustion, and Restoration," Lt.-Col. J. W. Crile; "Manual of War Surgery at the Base," Lt.-Col. S. Barling and Capt. J. T. Morrison, illustrated; "Trench Fever," Major W. Byam; "The Nervous Heart," Dr. A. McNair Wilson, illustrated; and "Surgical Aspects of Typhoid and Paratyphoid Fevers," Col. A. E. Webb-Johnson, illustrated (*H. Frowde and Hodder and Stoughton*); "Catalysis in Industrial Chemistry," Prof. G. G. Henderson; "The Human Machine and Industrial Efficiency," Prof. F. S. Lee; "Experimental Education," Dr. R. R. Rusk; "Education and Social Movements, 1700–1850," A. E. Dobbs; and a new edition, in three volumes, of "A System of Physical Chemistry," Prof. W. C. McC. Lewis (*Longmans and Co.*); "The Problem of Nervous Breakdown," Dr. E. L. Ash (*Mills and Boon, Ltd.*); "Rudiments of Handicraft," W. A. S. Benson (*John Murray*); "Mental Disorders of War," Prof. J. Lepine, edited by Dr. C. Mercier; "Electro-Diagnosis of War," Prof. A. Zimmern and P. Perol, edited by Dr. E. P. Cumberbatch; "Disabilities of the Locomotor Apparatus: The Result of War Wounds," Prof. A. Broca, edited by Major-Gen. Sir R. Jones; and "Wounds of the Pleura and Lungs," Prof. R. Grégoire and Dr. Courcoux, edited by Lt.-Col. C. H. Fagge (*University of London Press, Ltd.*).

OUR ASTRONOMICAL COLUMN.

SCHORR'S COMET.—Messrs. Braae and Fischer-Petersen have recomputed the orbit of this comet, using observations extending from November 23 to December 10. They find that it is a periodic comet belonging to the Jupiter group.

$T = 1918$ Sept. $27{\cdot}5834$ G.M.T.
$\omega = 278^\circ\ 8'\ 11{\cdot}6''$
$\Omega = 117^\circ\ 56'\ 28{\cdot}2''$ } 1918·0
$i = 5^\circ\ 35'\ 16{\cdot}3''$
$\phi = 28^\circ\ 10'\ 46{\cdot}9''$
$\log a = 0{\cdot}551909$
Period $= 6{\cdot}72764$ years.

Ephemeris for Greenwich Midnight.

		R.A. h. m. s.	N. Decl. ° ′	Log r	Log Δ
January	7	3 57 34	14 46·9		
	11	3 59 1	15 12·4	0·3187	0·1177
	15	4 0 56	15 38·5		
	19	4 3 18	16 5·0	0·3246	0·1487
	23	4 6 6	16 31·5		
	27	4 9 19	16 58·1	0·3308	0·1798
	31	4 12 54	17 24·6		
February	4	4 16 50	17 50·8	0·3370	0·2106

OPPOSITION OF JUNO.—Juno will be in opposition on January 20, its magnitude being 7·8. The following ephemeris is from the Circular of the Berlin Rechen-Institut:—

		R.A. h. m. s.	N. Decl. ° ′	Log r	Log Δ
January	5	8 20 53	0 49	0·344	
	13	8 14 11	1 32		0·108
	21	8 6 59	2 32		0·110
	29	7 59 59	3 44		0·117
February	6	7 53 53	5 4		0·130
	14	7 49 11	6 27	0·363	

TWELVE NEW SPECTROSCOPIC BINARIES.—In a communication to the Journal of the Royal Astronomical Society of Canada (vol. xii., p. 460) Dr. J. S. Plaskett gives particulars of the first twelve spectroscopic binaries which have been discovered with the aid of the new 6-ft. reflecting telescope of the Dominion Astrophysical Observatory at Victoria, B.C. The variable velocities of these stars were detected in the course of the measurement of some of the 750 spectra secured between the arrival of the mirror at the observatory on April 29 and the third week in October. The magnitudes of the stars involved range from 5·0 to 6·32, and it would thus appear that very rapid progress in this field of observation may now be expected. The two stars Boss 4870 and Boss 5236, which are assigned to class A by the Harvard observers, have been found to be of early B type.

THE MINOR PLANET 692 HIPPODAMIA.—This small planet has given a good deal of trouble to those who have endeavoured to follow its movements. Both the eccentricity and inclination are large, the declination at opposition ranging from $+51^\circ$ to -49°, and the magnitude from 12·3 to 14·1. The planet was observed in 1902 and 1911, but sought unsuccessfully in 1915. M. H. Dubosq-Lettré gives new orbit elements in the *Journal des Observateurs* (vol. ii., No. 11), and appeals to observers to search for it.

OBSERVATIONS OF EROS.—The *Journal des Observateurs* (vol. ii., No. 11) contains a series of photographic observations of 433 Eros, made in 1917 at the Cape Observatory by Mr. J. Voûte. Owing to its high south declination (about 50°) the planet was invisible in Europe. It will again be in opposition next summer, but, being near aphelion, it will be faint.

PARIS ACADEMY OF SCIENCES.

PRIZES PROPOSED FOR 1920.

THOSE prizes marked with an asterisk are without restriction of nationality.

Mathematics.—*Poncelet prize (2000 francs), for the author of the work most useful to the progress of pure mathematics; Francœur prize (1000 francs), for similar work in pure or applied mathematics.

Mechanics.—Montyon prize (700 francs), for the invention or improvement of instruments useful to the progress of agriculture, the mechanical arts, and practical and theoretical sciences; Fourneyron prize (1000 francs), subject proposed: The theoretical and experimental study of the question of internal-combustion turbines; Henri de Parville prize (1500 francs), for original work in mechanics.

Astronomy.—*Lalande prize (540 francs, a gold medal, or its value), for the author of the most interesting observation or work most useful to the progress of astronomy; Damoiseau prize (2000 francs), question proposed: To improve in some important points the works of Poincaré and of Liapounoff on the figures of equilibrium relating to a fluid mass in rotation submitted to the Newtonian attraction. The Academy specially directs attention to the question of stability and the study of the infinitely small oscillations round a stable figure. The question set for 1917 is given again for 1920, to calculate more exactly, taking account of the results of recent expeditions, the attraction of the moon on the raised ring formed at the surface of the earth by the tides. To examine the effect of this attraction on the angular velocity of rotation of the earth; Benjamin Valz prize (460 francs), for work on astronomy conforming to the conditions for the Lalande prize; the *Janssen prize (a gold medal), for the author of a work or discovery constituting direct progress in the field of physical astronomy; *Pierre Guzman prize (100,000 francs), to anyone finding a means of opening communication with a planet (excluding Mars). Failing solution, the interest will be awarded for real and serious progress, either in the knowledge of the planets of the solar system, or in the relations of the planets of this system with the earth, by means of improved physical or optical instruments, or by any other mode of inspection or investigation.

Geography.—Delalande-Guérineau prize (1000 francs), for a French traveller or savant whose work has been the most useful to France or to science; Gay prize (1500 francs), question proposed: The geographical distribution of tropical plants presenting a practical utility; *Tchihatchef foundation (3000 francs), as recompense for or assistance to naturalists distinguished in the exploration of the Asiatic continent or adjacent islands, especially the lesser-known regions (British India, Siberia, Asia Minor, and Syria excluded). The explorations may have as object any branch of the natural, physical, or mathematical sciences, but such sciences as archæology, history, ethnography, and philology are excluded. The work must be the result of personal observation; Binoux prize (2000 francs), for the author of works on geography or navigation.

Navigation.—Prize of 6000 francs, as a recompense for progress increasing the efficiency of the French naval forces; Plumey prize (4000 francs), for the author of an improvement in steam-engines, or any other invention contributing most to the progress of steam navigation.

Physics.—*L. La Caze prize (10,000 francs), for the best work on physics; Hébert prize (1000 francs), for the author of the best treatise or most useful discovery for the popularisation and practical employment of electricity; Hughes prize (2500 francs), for the author of an original discovery in physical science, especially electricity and magnetism or their applications; Clément Félix foundation (2500 francs, undivided), for a Frenchman devoting himself to the study of electricity, and, having already furnished proofs of ability, to facilitate the continuation of his researches.

Chemistry.—Montyon prize, unhealthy trades (2500 francs, a mention of 1500 francs), for the discovery of a means of rendering some mechanical art less unhealthy; Jecker prize (10,000 francs), for the author of the most useful work on organic chemistry; *L. La Caze prize (10,000 francs, undivided), for the best work in chemistry; Cahours prize (3000 francs), for the encouragement of young men already known by their work, particularly by chemical researches; Houzeau prize (700 francs), for a young deserving chemist.

Mineralogy and Geology.—Fontannes prize (2000 francs), to the author of the best palæontological publication; Victor Raulin prize (1500 francs), restricted to authors of French nationality for facilitating the publication of works relating to mineralogy and petrography.

Botany.—*Desmazières prize (1600 francs), for the best or most useful work on cryptogams; Montagne prize (1500 francs), for important discoveries or works on the cellular plants; de Coincy prize (900 francs), for a work on phanerogams, written in Latin or French.

Anatomy and Zoology.—Cuvier prize (1500 francs), for work in anatomy and zoology; Savigny foundation (1500 francs), for the assistance of young travelling zoologists, not in receipt of Government grants, who specially occupy themselves with the invertebrate animals of Egypt and Syria.

Medicine and Surgery.—Montyon prize (three prizes of 2500 francs, three honourable mentions of 1500 francs, citations), for improvements in medicine and surgery; Barbier prize (2000 francs), for a valuable discovery in surgery, medicine, pharmacy, or botany having relation to the art of healing; Bréant prize (100,000 francs), for the discovery of a means of curing or eradicating Asiatic cholera. Failing this award, the interest will be given to anyone advancing science on the question of cholera or any other epidemic disease; Godard prize (1000 francs), for the best memoir on the anatomy, physiology, and pathology of the genito-urinary organs; Mège prize (10,000 francs), for the author who shall continue and complete the essay of Dr. Mège on the causes which have favoured or retarded the progress of medicine. The interest may be disposed of by the Academy until such time as it thinks fits to award the prize; Dusgate prize (2500 francs), to the author of the best work on the diagnostic signs of death, and on the best means of preventing premature burial; Bellion prize (1400 francs), for work or discoveries profitable to the health of man or the amelioration of the human species; Baron Larrey prize (750 francs), for a doctor or surgeon (Army or Navy) for the best work presented to the Academy in the course of the year dealing with military medicine, surgery, or hygiene.

Physiology.—Montyon prize (750 francs), for the most useful work on experimental physiology; Lallemand prize (1800 francs), for work relating to the nervous system in the widest sense of the words; *L. La Caze prize (10,000 francs, undivided), for work contributing to the progress of physiology; Martin-Damourette prize (1400 francs), for work in therapeutic physiology; Philipeaux prize (900 francs), for experimental physiology.

Statistics.—Montyon prize (1000 francs, two men-

tions of 500 francs), for statistical research in any field.

History and Philosophy of Science.—Binoux prize (2000 francs).

Medals.—Arago medal, awarded by the Academy for a scientific discovery of outstanding merit; Lavoisier medal, for eminent services in chemistry; Berthelot medals, awarded annually to the recipients of prizes in chemistry.

General Prizes.—Prize founded by the State (3000 francs), subject proposed for 1920: To improve the theory of functions of a variable susceptible of representations by trigonometric series of several arguments, linear functions of this variable; Bordin prize (3000 francs), subject proposed: Study of the sedimentary breccias; Serres prize (7500 francs), for general embryology applied so far as possible to physiology and medicine; Houllevigue prize (5000 francs), for work in the physical sciences; Saintour prize (3000 francs), for the same; Henri de Parville prize (1500 francs), for a book on original science or scientific popularisation; Lonchampt prize (4000 francs), to the author of the best memoir on the diseases of man, animals, and plants, especially from the point of view of the introduction of mineral substances in excess as the cause of these diseases; *Henry Wilde prize (4000 francs), for discovery or work in astronomy, physics, chemistry, mineralogy, geology, or experimental mechanics; Caméré prize (4000 francs), for a French engineer who has personally conceived, studied, and realised a work the use of which results in progress in the art of construction; Gustave Roux prize (1000 francs, undivided); Thorlet prize (1600 francs).

Special Foundations.—Lannelongue foundation (2000 francs), for the assistance of one or two persons in needy circumstances connected with the scientific world.

Prix des Grandes Ecoles.—Laplace prize (works of Laplace), to the student leaving the Ecole Polytechnique with the first place; L.-E. Rivot prize (2500 francs), between the four students leaving each year the Ecole Polytechnique with first and second places in the *corps des mines* and the *ponts et chaussées*.

Foundations for Scientific Research.—Trémont foundation (1000 francs), for assisting work useful to France; Gegner foundation (4000 francs), to assist a struggling scientific man already known by his work; Jérome Ponti foundation (3500 francs), for work in physical science; Henri Becquerel foundation (3000 francs), to be used for furthering the progress of science; Bonaparte fund (minimum grant 2000 francs), for facilitating researches by workers known by their original publications, and who lack sufficient researches to undertake or continue their investigations; Loutreuil foundation (125,000 francs), for encouraging the progress of science in colleges in Paris and the provinces (excluding the universities), as well as by independent workers, the creation and equipment of laboratories, the development of collections, libraries, scientific publications, and scientific expeditions.

THE ASSOCIATION OF PUBLIC SCHOOL SCIENCE MASTERS.

THE nineteenth annual general meeting of this association was held at the London Day Training College on December 31 and January 1. During the discussions the predominant topic was the danger of undue specialisation on the part of boys at school. It was refreshing to notice that science masters do not merely grumble at the unfair amount of time devoted to the more deep-rooted subjects of school curricula, but also recognise the error of early specialisation within their own subject. This note was struck by Sir Ronald Ross, who presided throughout the meeting. In his opening address (the main part of which appears elsewhere in this issue) he said that it was not only in their classical studies that the boys were kept too long pottering about the porch of the temple; that error also lies in attempting too much detail at the outset.

The recent meetings of the association have shown that more and more importance is being given to breadth of view in the teaching of science to young boys. There is a breaking away from the traditional chemistry, heat and light, as the only suitable scientific food for the young. Mr. W. D. Eggar said that at Eton College the experiment had been tried of making the classical masters responsible for some of the science teaching in the lower parts of the school. During the past term astronomy had provided the subject-matter, and he was well satisfied with the work that had been done. In the course of the discussion which followed Mr. Eggar's speech there were frequent expressions of dissatisfaction with the new regulations of the Oxford and Cambridge Joint Examining Board for the School Certificate Examination. A resolution was passed that the syllabus should be broadened by the inclusion of an alternative paper on general science.

The Rev. S. A. McDowall spoke of the science taught to the classical Sixth Forms at Winchester College. By the time the boys have reached this eminence they have spent some years in learning the grammar of science. Then the attempt is made to co-ordinate their knowledge, to draw general conclusions, and to learn something of the philosophy of science. "The aim is," to quote Mr. McDowall's words, "that the boy shall leave school with a certain power of detached judgment and criticism; that his attitude to the experiences of his ordinary life shall be a scientific one; and that he shall feel that physical and chemical facts underlie human activities and human problems."

Mr. F. S. Young, headmaster of Bishop's Stortford College, urged the importance of restricting specialisation in examinations for scholarships at the universities. The present system, he said, led to narrowness of outlook. He suggested that candidates should not be admitted to such examinations unless they had shown evidence of a satisfactory general education; that they should be required to offer subjects both cognate with and subsidiary to their main one; and that their performance in these should be considered fully in the awarding of scholarships. Mr. A. Hutchinson (Pembroke College, Cambridge) said that when the present system of scholarship examinations originated, education at the public schools was synonymous with specialisation in classics. He thought that even under present conditions candidates for science scholarships were less specialised than their classical and mathematical brethren, as they had for the most part a considerable mathematical equipment in addition to their knowledge of science. At Cambridge, he said, great care was now taken that candidates who offered two subjects, *e.g.* history and modern languages, were given full credit for their work, even if they failed to reach in either subject the standard attained by candidates who offered one subject only. Prof. A. C. Seward (Master of Downing College, Cambridge) said that at present the standards required in the candidates' special subjects were far too high, and that, so far, the means applied for testing the general knowledge of the candidates had, for the most part, been farcical. Col. A. Smithells (professor of chemistry, University of Leeds) considered that the difficulty had been met in his own

university by bringing the award of scholarships within the domain of the Joint Matriculation Board, higher papers being set for this special purpose. The good working of the system, he said, was owing to the fact that the Matriculation Board contained a substantial body of representatives of the schools.

In connection with the meetings there was an exhibition of apparatus, etc. Perhaps the most important thing shown was the use of crystal violet to compare the hydrion content of aqueous solutions of acids by the colours obtained on adding measured proportions of the dye. The "weaker" the acid, the nearer is the tint to the violet end of the spectrum. Mr. R. G. Durrant (Marlborough College) claims that the margin of error in comparison with conductivity data is very narrow, and that his method is both simple and quick. Mr. Durrant also showed the use of malachite-green solution in differentiating the flames of the alkali and alkaline earth metals by cutting out the orange band from the spectrum; by this means the calcium flame appears bright green and the strontium one ruby-red.

During the nineteen years of its life the membership of the association has been restricted to the public schools. The basis has now been broadened so as to include science masters in any secondary school which is under the control of a corporate body. The name has therefore been changed to "The Science Masters' Association." Mr. W. D. Eggar, of Eton College, and Capt. W. J. R. Calvert, of Harrow School, are the new secretaries. Mr. W. W. Vaughan, the Master of Wellington College, was elected president of the association for the coming year.

MR. FISHER AND THE BOARD OF EDUCATION.

MR. LLOYD GEORGE is presumably busy forming his new Government, and rumour has it that many changes of *personnel* are imminent. Some two years ago, on the formation of the second Coalition Government, a novel departure was made under the stress of war conditions in the selection of men for certain appointments, not in virtue of political services for which due reward must be found, but in respect of peculiar fitness and proved experience of the work to be done. Among those invited to accept office was Mr. H. A. L. Fisher, Vice-Chancellor of the University of Sheffield, who had won the confidence of all classes in the area covered by the operations of the University by the tact, judgment, and broad sympathy with all forms of education he had displayed in the discharge of his duties. He was invited by Mr. Lloyd George to accept the Presidency of the Board of Education vacated by Lord Crewe, and he consented, a seat in the House being found for him in the Hallam division of Sheffield. Mr. Fisher has proved a success, not merely in the discharge of his duties as President, but also in the advocacy of a far-reaching, not to say revolutionary, Education Act, and of a measure of long-delayed justice to the teachers in the shape of a Superannuation Act, which will go far to make the profession of the teacher attractive. He has won golden opinions by the skill and judgment he displayed in piloting these measures through the House, and he has breathed a new atmosphere into the Board of Education which "brings hope with it and forward-looking thoughts." These two measures stand to his infinite credit; they still need careful guidance in order to reap their full fruit and to make way for further developments; and yet it is said that a change in Mr. Fisher's position is imminent, born of his very success. No department of the State has suffered more than that of education by the constant changes of its chief—there have been no fewer than ten since 1902—but it would not be so were its status and its vital importance to the national well-being rightly regarded. It ought to rank with the highest Cabinet offices, and be remunerated accordingly. It demands special knowledge and experience for its due discharge, and in Mr. Fisher we have the man who rejoices in both, united with an enthusiasm and devotion but rarely witnessed. That he should be assigned some other duties in the political sphere would excite a feeling of grave disappointment throughout the country at this critical time.

At the annual meeting of the Incorporated Association of Headmasters on January 3, the president of the association, Mr. F. B. Malim, Master of Haileybury College, proposed, and the Rev. Dr. David, Headmaster of Rugby, seconded, the following resolution, which was adopted unanimously:—"That this association desires to express its profound satisfaction at the educational developments initiated and carried by Mr. Fisher as Minister of Education, and its conviction that it is of the first importance in the interests of the nation that Mr. Fisher should continue in that office and should be enabled to complete the great work of which he has made so admirable a beginning; and that this association would regard it as a national calamity if Mr. Fisher should be required to leave the Board of Education at this juncture."

Following the headmasters' lead, the teachers assembled at the joint conference of educational associations at University College, London, on January 4, carried unanimously a resolution in the same sense, which was proposed by Sir Henry Hadow and seconded by Miss Busk. The motion was in the following words:—"This conference, composed of thirty-nine educational associations, which is now assembled at University College, London, wishes to urge the importance of retaining Mr. Fisher as Minister of Education. The educational developments accomplished by him during his period of office have given profound satisfaction to the teaching profession. Further, the confidence established between the Board of Education and teachers through Mr. Fisher's appointment and achievements has inspired teachers with a high sense of their responsibility in the training of the youth of the nation, and it is of the utmost importance that this confidence should be maintained and strengthened by the continuance of Mr. Fisher in the office of Minister of Education."

OBSERVATIONS ON THE RESULTS OF OUR SYSTEM OF EDUCATION.[1]

MANY problems of education would be solved if a really good scientific test of the results of education could be invented. I can imagine that if such a test were to be applied, say, once a year to all the forty million or so residents in this country, beginning with the British workman and ascending, or descending, to the Houses of Parliament, and even to the Royal Society, the results might be surprising. But as no such test is known, all we can do is to try to form some kind of personal estimate and integration, just as we try to measure lengths and areas by the eye—a method full of fallacies, but unfortunately, perhaps, the only one available. I propose, therefore, to offer for your consideration, as briefly as possible, my own life-notes on the subject.

Let us begin with physical education. Here, I think, the British system has deservedly set the fashion throughout the world. The young men of most coun-

[1] From the presidential address delivered at the annual meeting of the Association of Public School Science Masters on December 31, 1918, by Col. Sir Ronald Ross K.C.B. K.C.M.G., F.R.S.

tries have certain national games, but since the time of the ancient Greeks no nation has so assiduously practised in the whole field of bodily exercise—very much, in my opinion, to our advantage. That field is a very large one—first, the great natural exercises, running, swimming, rowing, riding, and climbing; secondly, the games, cricket, football, tennis, polo, and others; thirdly, the sports, fishing, shooting, and hunting; fourthly, special kinds of muscular training, such as gymnastics, boxing, and fencing; and, fifthly, military training. Now all these are invaluable, not only for the body, not only to maintain the *mens sana in corpore sano*, but also as exercises for most of the faculties of the mind and spirit. For this reason I attach the least value to the artificial exercises, so popular on the Continent, as gymnastics and fencing; and not so much to the games as to the natural exercises and sports. It has been the great merit of British education to have discovered the superlative educating capacity of what are often called mere pastimes and amusements. Yet this has been quite a modern discovery, and many nations are still only just learning the lesson from us. When I read Russian and French novels, and even some works of Dickens and other English writers, I seem to be living in a museum of pathological specimens, and not among men and women who have breathed God's air and seen the sunlight.

This leads to the all-important question of human physique—too large a theme for discussion now. But from my own observations made in many countries I conclude that variations in physique show such peculiar local distribution that we must attribute them more to environment than to heredity. What the principal cause of physical deterioration, combined as it generally is with mental and moral deterioration, may be escapes me. It cannot be entirely disease, or alcoholism, or underfeeding, or overcrowding, or climate, but must be some unknown factor which has not yet been discovered. On the other hand, speaking as a military medical officer, I will say with certainty that a period of open-air military training under discipline, combined with good food, greatly improves the physique, the health, and the mental powers of young men, let alone their manners and *morale*. For this reason I should be in favour of universal military training everywhere; but, on the other hand, I admit the force of the argument that such military training may be an incentive to puerile wars—though I am not sure of it. On the whole, therefore, I would at least suggest an alternative scheme—that is, a scheme of what I call "health conscription," consisting of at least a fortnight's compulsory physical training, under discipline, in the open air, for both sexes every year for five years between the ages, say, of fifteen and twenty. There will, of course, be the usual objections on the score of expense and interference with so-called liberty; but the alternative appears to me to be continued deterioration of body and mind. The public schools of Britain have set the example in what may be called physical religion; my proposal is merely to extend that faith to all classes.

Coming now to the actual knowledge obtained by the young in our schools, I have concluded that it is really not very much. My complaint (and that of others) is not so much as to the total amount of information imparted as to the direction of it. As everyone knows, our teaching has been concerned chiefly with mathematics and the classics, with the outlines of history and of English literature. First taking mathematics (which is a hobby of mine), my observation is that few young men know even the aims and objects of the science, much less its applications, although they may have studied it for years at school. If you ask them they will reply, "Mathematics is doubtless very fine, but I don't know what the dickens it is all about; and, anyway, it is no use to me." The reason for this is that the schoolboy is not pushed fast enough into the heart of the science, which is the calculus. He is kept, so to speak, pottering about with petty problems in the porch of the temple, and is never allowed to look into the temple itself and to see the beauties within. In fact, the whole subject is taught, not as a great science, but as an opportunity for exercising the mind by a system of puzzles. The error is that of entering into too great detail at the outset. Instead of climbing the mountain, we are kept wandering among the boulders at its base; we become tired; we abandon our enterprise; and the time and money spent on it are almost entirely wasted. I once wished to give a simple mathematical demonstration to a class of more than twenty medical officers; only one of them knew the meaning of a differential coefficient!

As regards the classics, my complaint is, not that boys are taught the "humanities," but that they are *not* taught them. The fundamental mistake seems to be the same as in mathematics—too great detail at the outset. The study of the history, literature, art, and policies of the human race degenerates into the meticulous study of the alphabet of the subject only—that is, Greek and Latin grammar. Why do we still learn these languages? In order to read Greek and Latin literature. But after we have spent years in learning the languages, we become so tired of them that we do not read the literature at all! I am a bad linguist, but an ardent admirer of classical literature; yet when I was a young man I noted that many of my friends were good linguists, but hated the literature. Surely a waste of time and money again. The book is opened; a few words are deciphered; the scholium is read; and the book is closed again—and for ever.

So also with our teaching in most things—we potter about the porch and never look into the temple at all. How often, for example, are our boys taken into the picture galleries, those great temples of the human spirit, and there taught the history and the meaning of the art enshrined in them? Or how often are they taken to hear the reading of our own national poems or the music of the great composers? Seldom, I think; and when they escape from school they take to the reading of shilling novels and the viewing of contemptible plays.

It is usually, and rightly, maintained that the aim of all education is to endow the young with character, judgment, and knowledge; but when people argue that the relative importance of these qualities is in the order given—that character comes first, then judgment, and lastly knowledge—I am inclined to disagree. We have here, indeed, a trinity of elements all necessary for educational salvation, but all three are so closely knit together that we cannot do without one of them. Without character one can possess neither judgment nor knowledge; without judgment, neither character nor knowledge; without knowledge, neither character nor judgment. How, for instance, may a person who consents to remain ignorant of all the knowledge which science has given to us be said to possess character? And as for judgment, it is not a faculty bestowed upon us *a priori* at birth, but one which grows with exercise. Shelley fixed the argument when he said of one of the highest virtues:

> Love is like understanding, that grows bright
> Gazing on many truths.

Similarly, breathing, sleep, and food are all necessary for bodily salvation; and one might as well say that

the relative importance of these is in the order named. The point is worth noting, because it has become the fashion lately to decry knowledge especially. "Be good," says one, "and let who will be wise"; and Tennyson exclaims of knowledge, "Let her know her place; she is the second, not the first."

Such sayings are based upon a false psychology; for the mind is not a thing of only one or two dimensions, but of three, and there is no first and no second where all three are equal. One might as well say, "It is nobler to breathe and to sleep than to eat; therefore let us do without food." And, indeed, this is the actual faith of the Indian fakir, leading to a futile philosophy which was becoming very prevalent even in this country before the war, and which I called "fakirism." When this evil spirit enters into the mind of a nation, that nation is doomed. Like the Indian fakir, it will be content to sit by the roadside of life and to achieve nothing thereafter except the pursuit of idle dreams, as many nations have done and are doing. It is your mission, I take it, to contend against this spirit, to rouse the fakir, and to put some of the abhorred beef and bread of natural science into him, so that he shall begin to do honest work again.

All this is really very pertinent to our theme. For if knowledge is of no account, why trouble to teach any at all? But if it is of some account, then why not teach knowledge that is useful as well as sound? But here we strike at once across two dogmas which I have often seen repeated in educational literature. The first is that the object of education is not to impart knowledge, but to exercise the mind in the art of acquiring knowledge for itself in after-years. There is some truth in that, but also a fallacy. For how can we exercise a mind in the art of acquiring knowledge except by the practice of that art? We might as well try to teach a boy to swim without putting him in the water. Then there is the second dogma, which is just the opposite—that what is taught at all must be taught thoroughly. Now I am no teacher of young boys myself, but I doubt the policy. I think that it is advocated in disregard of the natural law that living beings tend to hate a food which is offered to them too constantly. Moreover. we can never know in which direction a boy's aptitude really lies; and, lastly, it is impossible to teach anything thoroughly to anyone, for all knowledge is infinite. I conclude, therefore (though I may be wrong), that it is not good to bury a youth at the bottom of a mine in order that he shall search there for some gold which perhaps he will never find; but that it is better to take him speedily to a height whence he can survey the whole world and choose for himself the field for his own future work.

Neither you nor I will pretend that natural science is to be the only subject to be taught; but I cannot conceive how anyone who does not possess some broad knowledge of the immense accumulation of facts about Nature collected by humanity during the last two thousand years can dare to call himself an educated person. Some years ago a headmaster whose name I have forgotten maintained that a study of the stars is unimportant for men. He meant, not men, but earthworms. A man is, or ought to be, something more than an animal, and the very definition of him is that he *shall* study the stars.

Of course, in this very brief survey I have been obliged to omit reference to some points even of the first importance, such as manners and *morale*, for instance; and to exclude university education, which is the privilege only of a few persons. I will conclude now with the following summary of my own opinions—for what they are worth. I think that our system of open-air education, in which the public schools set the example, is a most invaluable and essential part of education. Closely connected with it is the principle of personal honour, good temper, and duty—that is, a spirit of *noblesse oblige*, which that open-air education, more than anything else, fosters and inculcates. On the other hand, I think that our system of education is defective as regards the imparting of fundamental knowledge. Most of the great knowledges of humanity are not implanted in the minds of our youth—not only the great discoveries of science, but also the great discoveries of literature, including classical literature, and of the high poetry, painting, music, and philosophy, which constitute the principal heritage of the human race. Indeed, knowledge is often actually derided by the numerous apostles of "fakirism" in this country, or replaced by a useless lumber of unimportant matter; and foreign languages and many of the petty but useful arts of life are much neglected. Hence the whole intellectual side of life is too frequently ignored, or even despised, by the masses of the people, with the result that their judgment is starved for lack of facts, and that they become too often the slaves of fads and quackeries and unproven dogmas of every description—party politics, meretricious propagandas, ignoble creeds, and even sometimes superstitions that savages would laugh at. But behind these and other defects the nation possesses by nature a kindliness, a sense of humour and fair play, and an unopposable force of good intention which have made it during the last four years the pattern and exemplar of the world.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

DR. M. C. RAYNER has resigned her appointment as lecturer in botany (lecturer-in-charge) at University College, Reading.

DR. R. M. CAVAN, of the chemistry department of University College, Nottingham, is leaving shortly to take up his duties as principal of the Technical College, Darlington.

THE sum of 3000*l.* has been given by Mr. G. T. Hawkins, of Northampton, towards the building and equipment of a pathological laboratory at the Northampton General Hospital.

MR. W. H. WATSON, of the chemistry department of the Northern Polytechnic Institute, has been appointed vice-principal and head of the chemistry and natural science department of the Municipal College, Portsmouth.

THE organised laundry trade is establishing a research department, the object being to increase efficiency through science and invention, and towards this a Croydon launderer has offered 100*l.* and 50*l.* yearly for five years.

TWO Theresa Seessel research fellowships, each of the value of 200*l.*, are being offered by Yale University. The fellowships are intended to promote original research in biological studies, and are open to men or women. Applications, accompanied by reprints of scientific publications, letters of recommendation, and a statement of the particular problem which the candidate is prepared to investigate, must be made before April 1 next to the Dean of the Graduate School, New Haven, Conn., U.S.A.

GOOD progress has been made in the formation of the Society of British Science Students, to the inauguration of which attention has been directed already in these columns. A temporary executive has been elected, of which Mr. P. E. Owens, 28 Jesse

Terrace, Castle Hill, Reading, is the hon. secretary. The principal object of the society is to strengthen the relations between the younger students of science in this country by means of meetings, lectures, and publications, and by other suitable measures. The society will endeavour to secure privileges for its members in regard to other societies and to circulate information among the members relating to scholarships, vacant appointments, and so on. All inquiries should be addressed to the hon. secretary.

THE *Publishers' Circular and Booksellers' Record* records a total of 7716 books as having been published during the year 1918. This is a decrease of 415 compared with the previous year, and it is accounted for chiefly by a falling off in the number of works of fiction (−523) and juvenile literature (−155); other classes that have also decreased slightly are education, agriculture, domestic, business, history, and geography. On the other hand, sociology has increased by 112, technology by 110, medicine by 80, and poetry by 98. Under "Science" the number of new books recorded is 232, also 5 translations and 28 pamphlets. In addition, there were 64 new editions, making a total of 329. In the year 1914 science occupied the third place in twelve classes of literature, and technology the fifth place; in 1918 technology was in the eighth place and science in the tenth.

A COURSE of nine lectures on dynamical meteorology will be given at the Meteorological Office, South Kensington, by Sir Napier Shaw, reader in meteorology in the University of London, on Fridays, at 3 p.m., beginning on January 24. Each lecture will be followed by a conversation class for the discussion of practical details and of references to the original sources of information. The informal meetings at the Meteorological Office for the discussion of important current contributions to meteorology, chiefly in Colonial or foreign journals, will be resumed at 5 p.m. on Monday, April 28, and will be continued on each Monday until June 23, with the exception of June 9. Students wishing to attend should communicate with Sir Napier Shaw. The lectures are intended for advanced students of the University of London and others interested in the subject. Admission is free by ticket, obtainable on application at the Meteorological Office.

THE London County Council has arranged a series of special lectures for teachers, on subjects connected with problems of reconstruction, for the spring and summer terms of the present year. Full particulars are contained in the "Handbook of Classes and Lectures for Teachers" published by the Council. Among the numerous courses of lectures the following may be mentioned: the last three of the series on "Science and the Nation," viz. engineering, with special reference to its relations with our national life, by Prof. W. E. Dalby, at 11 a.m. on January 25, at the City and Guilds Engineering College of the Imperial College of Science and Technology, South Kensington; pure science in relation to the national life, by Prof. A. Schuster, at 11 a.m. on February 15, at the Regent Street Polytechnic, W.1; some aspects of the rubber-growing industry, by Prof. J. B. Farmer, at 11 a.m. on March 8, at the Regent Street Polytechnic, W.1. At King's College, Strand, on Wednesdays, at 5.30 p.m., beginning on February 5, a course of public lectures on "Physiology and National Needs" will be delivered. The lectures include physiology and the food problem, by Prof. W. D. Halliburton; physical training of the open-air life, by Dr. M. S. Pembrey; "vitamines"—unknown but essential accessory factors in diet, by Prof. F. G. Hopkins; scurvy—a disease due to the absence of vitamine, by Prof. A. Harden; physiology and the study of disease, by Prof. D. N. Paton; and conservation of our cereal reserves, by Prof. A. Dendy. Applications for admission to these lectures should be addressed direct to the secretary of the college.

THIS year's educational gatherings included a joint meeting on January 2 of the Headmasters' Conference and the Incorporated Association of Headmasters, at which the reports of the Government Committees on science and modern languages were considered. After some discussion the following resolutions, dealing with the teaching of science and mathematics, were adopted by the conference:—(1) That suitable instruction in natural science should be included in the curriculum of preparatory schools, of the upper standards of elementary schools, and of all boys in public and other secondary schools up to the age of about sixteen. (2) That mathematics and natural science should be necessary subjects in the entrance scholarship examinations of public schools, in the first school examination, and in the examinations for entrance into the Navy and the Army, provided that good work in other subjects should compensate for comparative weakness in mathematics and natural science. (3) That for boys between twelve and sixteen the teaching of natural science should not be confined to physics and chemistry, but should include some study of plant and animal life, and that more attention should be directed to those aspects of science which bear directly upon the objects and experience of everyday life. (4) That there should be as close correlation as possible between the teaching of mathematics and of science. After a discussion of the report on the teaching of modern languages the conference passed resolutions, among others, declaring that the study of one or more languages other than English should be regarded as an essential part of higher education; that the first language other than English should be begun at about the age of ten, the second language not beginning until there was evidence of satisfactory progress in the first; and that usually the first language should be French and the second Latin.

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, December 18, 1918.—Mr. G. W. Lamplugh, president, in the chair.—C. T. **Trechmann**: A bed of inter-Glacial loess and some pre-Glacial freshwater clays on the Durham coast. A few years ago the author described a bed of Scandinavian drift that was found filling up a small pre-Glacial valley-like depression at Warren House Gill, on the Durham coast. This section, and others north and south of it, have been kept under observation at different times, and several new features have been noticed as the high tides and other agencies exposed parts of the coast. All the observed features seem to point to the fact that the Scandinavian ice-sheet advanced on the east coast of England in the same way as it invaded northern Europe round the southern shores of the Baltic, and gave rise to analogous climatic conditions leading to the formation of loess, a fragment of which is found protected from the erosive action of the later local glaciation in a small hollow on the Durham coast.

PARIS.

Academy of Sciences, December 23, 1918.—M. P. Painlevé in the chair.—C. **Guichard**: A series of surfaces of constant total curvature such that their lines of curvature form a network of the type $\phi A'$, $-\phi B'$.—M. Georges Charpy was elected a member of the divi-

sion of the application of science to industry.—P. **Fatou**: Suites of analytical functions.—G. **Julia**: Surfaces defined by a kinematic property.—J. **Guillaume**: Observations of the sun made at the Lyons Observatory during the second quarter of 1918. Summary of observations made on seventy-seven days of the spots, their distribution in latitude, and the distribution of the faculæ in latitude.—E. **Belot**: The *rôle* of the satellite material in the structure of the surfaces of the earth, the planets, and the sun.—A. **Portevin**: Comparison between the internal elastic equilibrium of alloys after tempering and after hardening by drawing in the cold. A comparison of the internal strains developed in a 60/40 brass by tempering at 760° C. in water and by wire-drawing.—MM. R. **Dubrisay**, **Tripier**, and **Toquet**: The miscibility of phenol and alkaline liquids. The relation between the temperature of complete miscibility of phenol and alkaline solutions of varying concentrations has been studied and the results given graphically.—L. F. **Navarro**: The constitution of the Island of Gomera (Canary Islands).—A. **Vacher**: The morphogeny of the roadstead of Brest.—P. **Pruvost**: The fossil fishes of the Coal Measures of the North of France.—M. **Molliard**: The influence of certain conditions on the comparative consumption of glucose and levulose by *Sterigmatocystis nigra* starting from saccharose.—A. **Paillot**: Some new parasitic coccobacilli of the cockchafer.

BOOKS RECEIVED.

Man's Redemption of Man: A Lay Sermon. By William Osler. Reprint. Pp. 63. (London: Constable and Co., Ltd.) 7*d*. net.

Chemistry Notes and Papers for School Use. (Notes and Question Papers to Supplement the Pupil's own Laboratory Notes.) Part i.: Introductory and First-year Work. In nine sections—A to I. Pp. 114. Part ii.: Second-year Work. In seven sections—A to G. Pp. 101. Part iii.: Third-year Work. In eight sections—A to H. Pp. 123. By G. N. Pingriff. (London: "Geographia," Ltd.) 2*s*. 3*d*. net each part.

A School Chemistry Method: Being the Teacher's Supplement to Chemistry Notes and Papers. Parts i., ii., and iii. By G. N. Pingriff. Pp. xii+80. (London: "Geographia," Ltd.) 1*s*. 9*d*. net.

Afforestation. By John Boyd. Pp. 39. (London: W. and R. Chambers, Ltd.) 1*s*. net.

La Face de la Terre (Das Antlitz der Erde). By Prof. E. Suess. Traduit avec l'autorisation de l'auteur et annoté sous la direction de E. de Margerie. Tome iii., 4e Partie. Tables Générales de l'ouvrage. Tomes i.-iii. Pp. 258. (Paris: A. Colin.) 25 francs.

From Darwinism to Kaiserism. By Dr. R. Munro. Pp. xviii+175. (Glasgow: J. Maclehose and Sons.) 4*s*. net.

Intravenous Injection in Wound Shock. By Prof. W. M. Bayliss. Pp. xi+172. (London: Longmans and Co.) 9*s*. net.

Can We Compete? By G. E. Mappin. Pp. x+149. (London: Skeffington and Son, Ltd.) 4*s*. 6*d*. net.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 9.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—M. B. Field: The Navigational (Magnetic) Compass as an Instrument of Precision.

OPTICAL SOCIETY, at 7.—Lt.-Col. A. C. Williams: The Design and Inspection of Certain Optical Munitions of War.

FRIDAY, JANUARY 10.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Rev. A. L. Cortie: The Spectrum of Nova Aquilæ, 1918, June 15.—J. K. Fotheringham: The New Star of Hipparchus and the Dates of Birth and Accession of Mithridates.—Rev. J. G. Hagen: Observations of Nova Aquilæ, 1918.—A. Stanley Williams: The Variable Star B.D.+39°, 3476.

MONDAY, JANUARY 13.

ROYAL INSTITUTION, at 3.—Prof. Spenser Wilkinson: Lessons of the War.

ROYAL GEOGRAPHICAL SOCIETY, at 8.—James Berry: Transylvania and its Relation to Ancient Dacia and Modern Rumania.

TUESDAY, JANUARY 14.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—A. G. Cooper: Slips and Subsidences on the Ceylon Government Railways.—F. W. Scott: Pietermaritzburg-Riet Spruit Deviation.

MINERALOGICAL SOCIETY, at 5.30.—A. Hutchinson: Stereoscopic Lantern-slides of Crystal Pictures.—L. J. Spencer: Mineralogical Characters of Turite (=Turgite) and some other Iron-ores from Nova Scotia.

WEDNESDAY, JANUARY 15.

ROYAL SOCIETY OF ARTS, at 4.30.—A. F. Kendrick: English Carpets.

ENTOMOLOGICAL SOCIETY, at 8.—Annual Meeting.

ROYAL MICROSCOPICAL SOCIETY, at 8.—J. E. Barnard: Presidential Address: The Limitations of Microscopy.

THURSDAY, JANUARY 16.

ROYAL INSTITUTION, at 3.—Prof. J. N. Collie: Chemical Studies of Oriental Porcelain.

ROYAL SOCIETY OF ARTS, at 4.30.—H. Kelway-Bamber, M.V.O.: Coal and Mineral Traffic on the Indian Railways.

LINNEAN SOCIETY, at 5.—Capt. A. W. Hill: The Care of Soldiers' Graves.—N. E. Brown: Old and New Species of Mesembryanthemum, with Critical Remarks.—Dr. J. R. Leeson: Exhibition of Mycetozoa from Epping Forest.

CHEMICAL SOCIETY, at 8.

FRIDAY, JANUARY 17.

ROYAL INSTITUTION, at 5.30.—Sir J. Dewar: Liquid Air and the War.

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